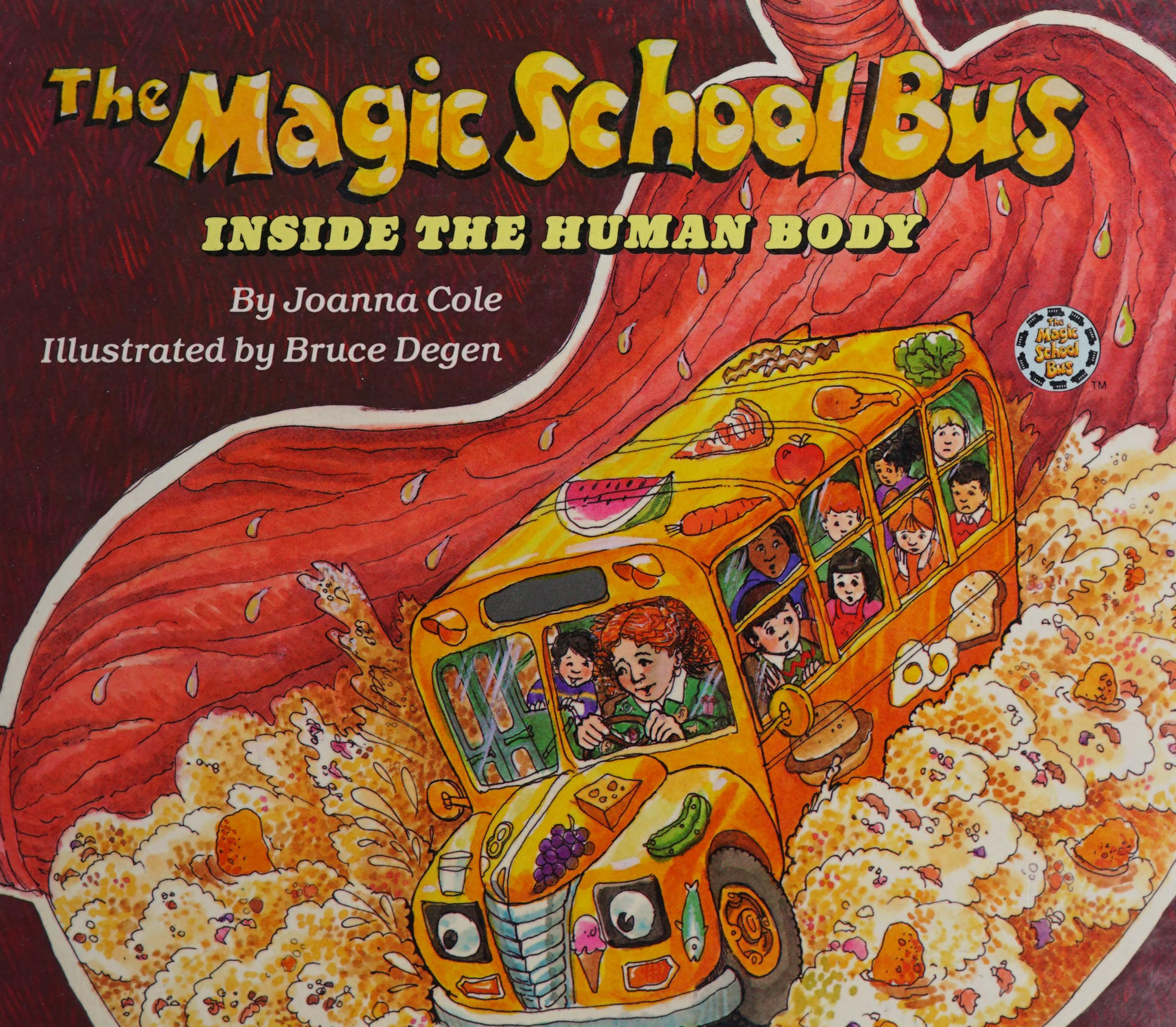


# The Magic School Bus

## INSIDE THE HUMAN BODY

By Joanna Cole

Illustrated by Bruce Degen





**T**alk about a change of plans! Ms. Frizzle and her class are on the Magic School Bus headed for a museum. They have been studying how the body turns food into energy, and now they are going to see an exhibit on the human body. Things seem fine until they stop for lunch. A strange mishap causes the bus to shrink and then be *swallowed*! Ms. Frizzle's class is suddenly inside a *real* human body!

"I thought we were going to a museum," says one of the kids.

"There's been a slight change of plans..." announces the Friz.

"We're being digested instead."

Yikes! Through the stomach and intestines, into the blood stream, the class travels to the heart, the lungs, the brain. How will they ever get out?

Fasten your seat belts! Joanna Cole and Bruce Degen have come up with another incredible trip on the Magic School Bus.













*Joanne*

# **The Magic School Bus Inside the Human Body**

By Joanna Cole

Illustrated by Bruce Degen



SCHOLASTIC INC. / New York



*The author and illustrator wish to thank Dr. Arnold J. Capute,  
Associate Professor of Pediatrics, Director, Division of Child Development,  
Johns Hopkins University School of Medicine, for his help in preparing this book.*

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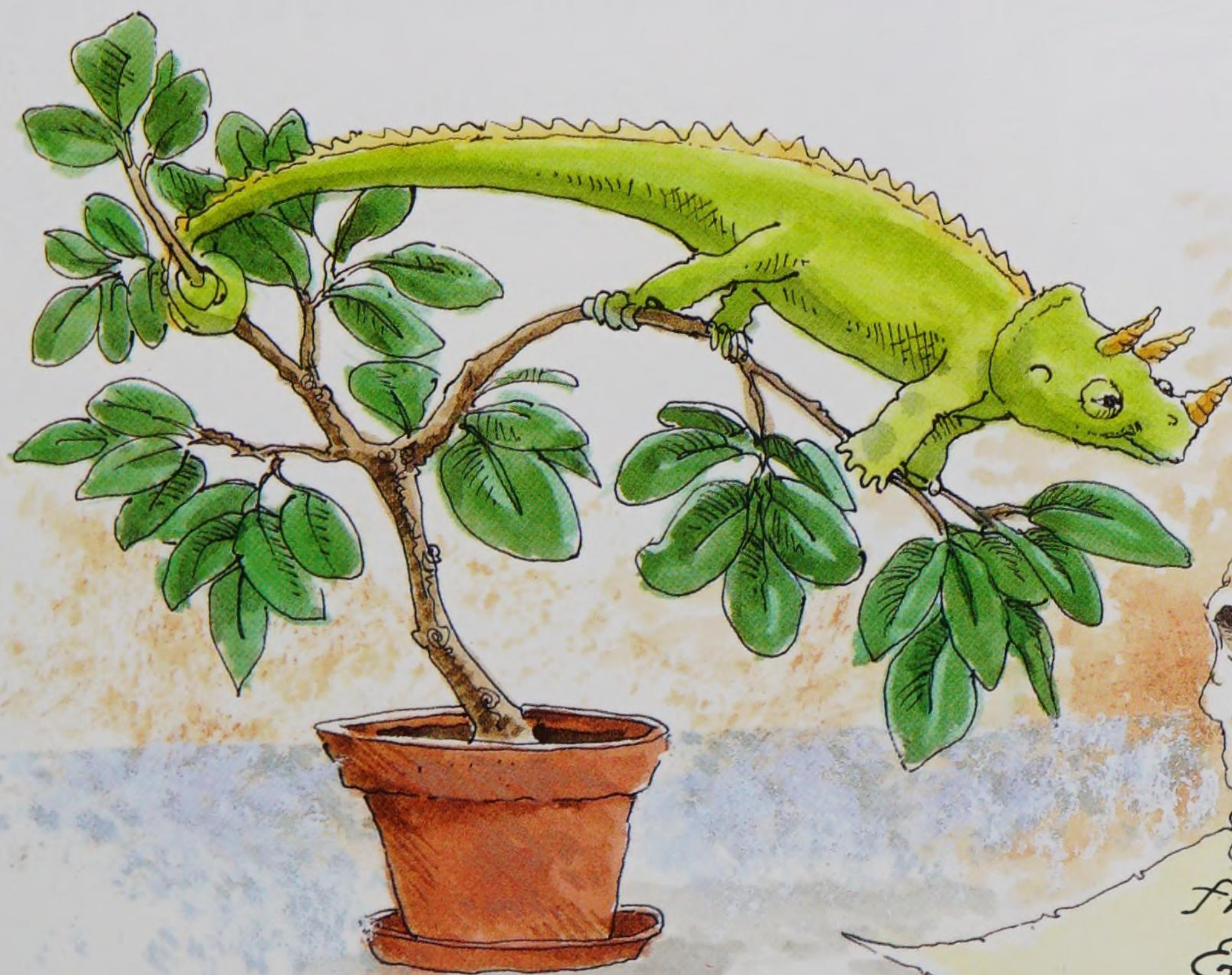
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To Craig  
from Joanna  
& Bruce





WE'RE GOING TO  
LEARN ABOUT  
OURSELVES.  
THIS SHOULD  
INTEREST YOU,  
ARNOLD!

It all began when Ms. Frizzle  
showed our class a filmstrip  
about the human body.  
We knew trouble was about to start,  
because we knew Ms. Frizzle  
was the strangest teacher in the school.

I CAN'T TAKE  
THE PRESSURE!



A FILM STRIP  
IS ONLY THE  
BEGINNING,  
YOU KNOW.

YEAH! I BET  
SHE HAS BOOKS  
ABOUT THIS,  
TOO.

WHEN'S  
RECESS?

**YOUR  
WONDERFUL  
BODY**





# YOUR BODY IS MADE OF CELLS by Rachel

Your body seems  
to be all one piece,  
but actually it is  
made of trillions  
of tiny pieces,  
called cells.

MY BODY IS  
MADE OF  
TRILLIONS  
OF CELLS.

SO IS MINE!



The very next day, The Friz made us  
do an experiment on our own bodies.

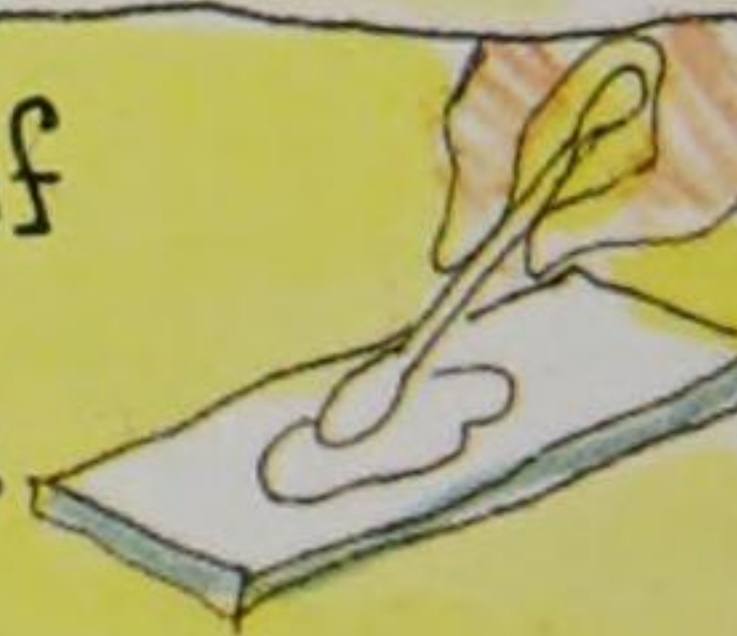
## SEE YOUR OWN CELLS

Most cells are so small that we can't see  
them without a microscope.

① Gently scrape  
inside of cheek  
with toothpick



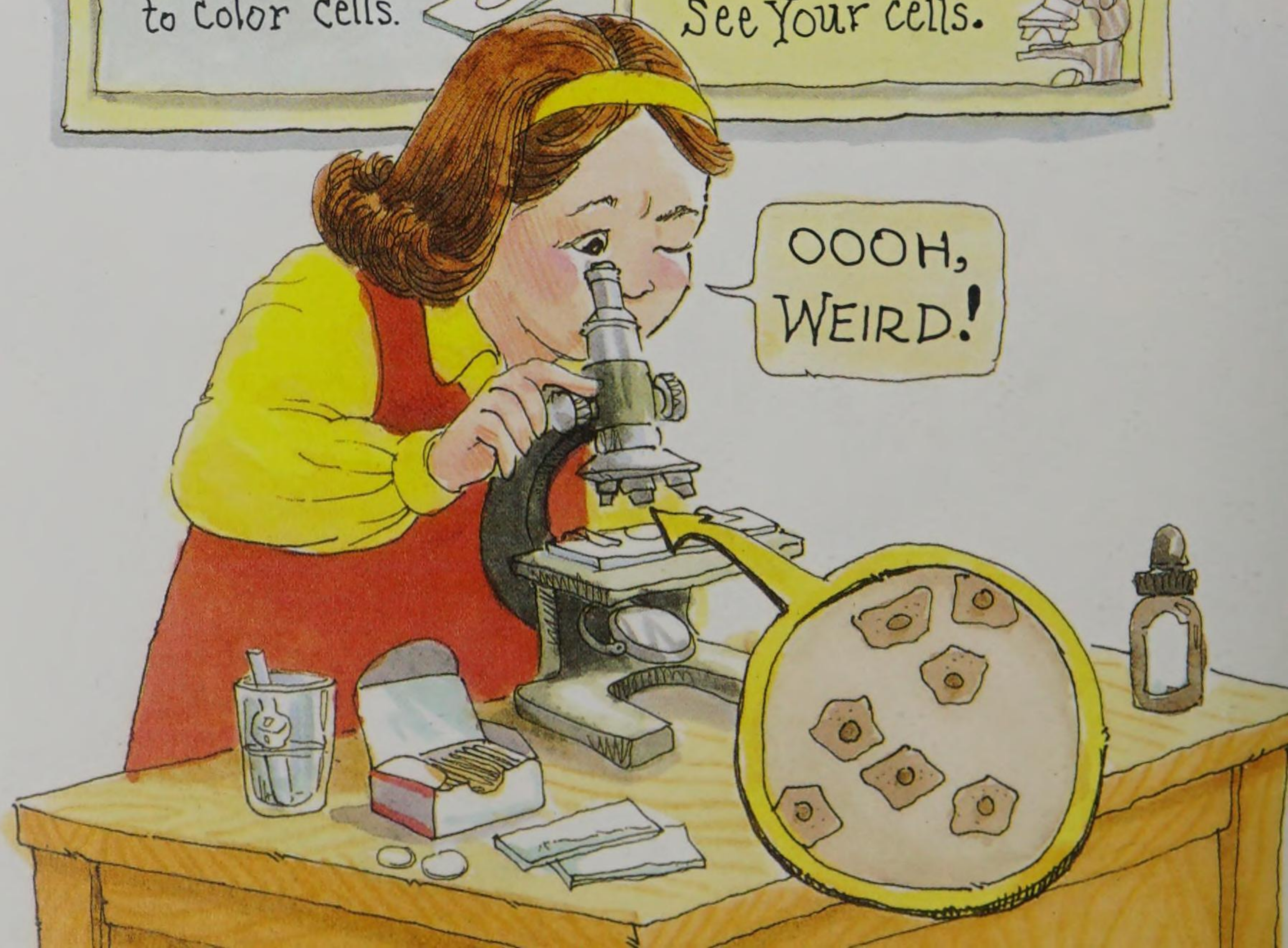
② Stir end of  
toothpick in  
drop of water  
on a slide.



③ Add a drop of  
Iodine Solution  
to color cells.



④ Look at slide  
under microscope.  
See Your cells.

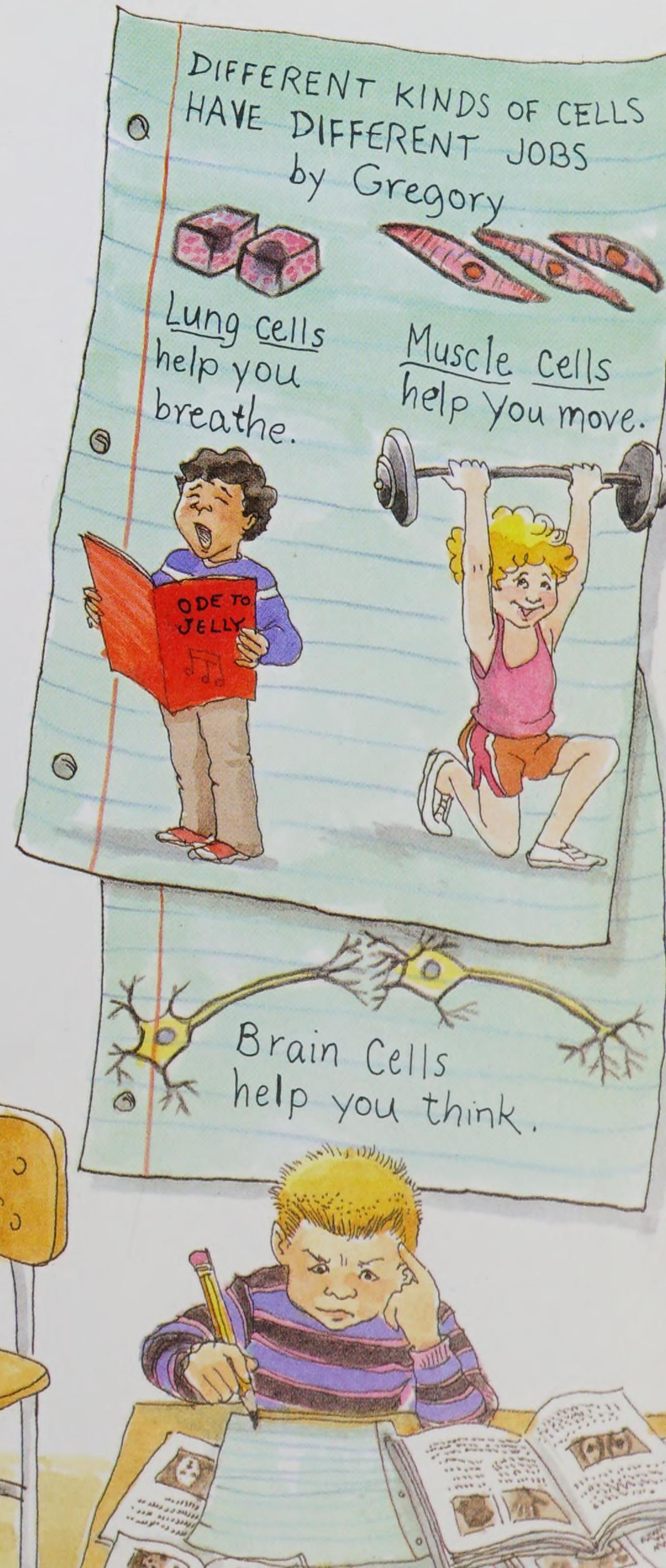




Then she announced that we were going on a class trip to the science museum. We were going to see an exhibit about how our bodies get energy from the food we eat.

YOUR CELLS NEED ENERGY  
TO HELP YOU GROW, MOVE,  
TALK, THINK, AND PLAY.

JUST BEING IN  
MS. FRIZZLE'S CLASS  
TAKES ALL MY  
ENERGY.

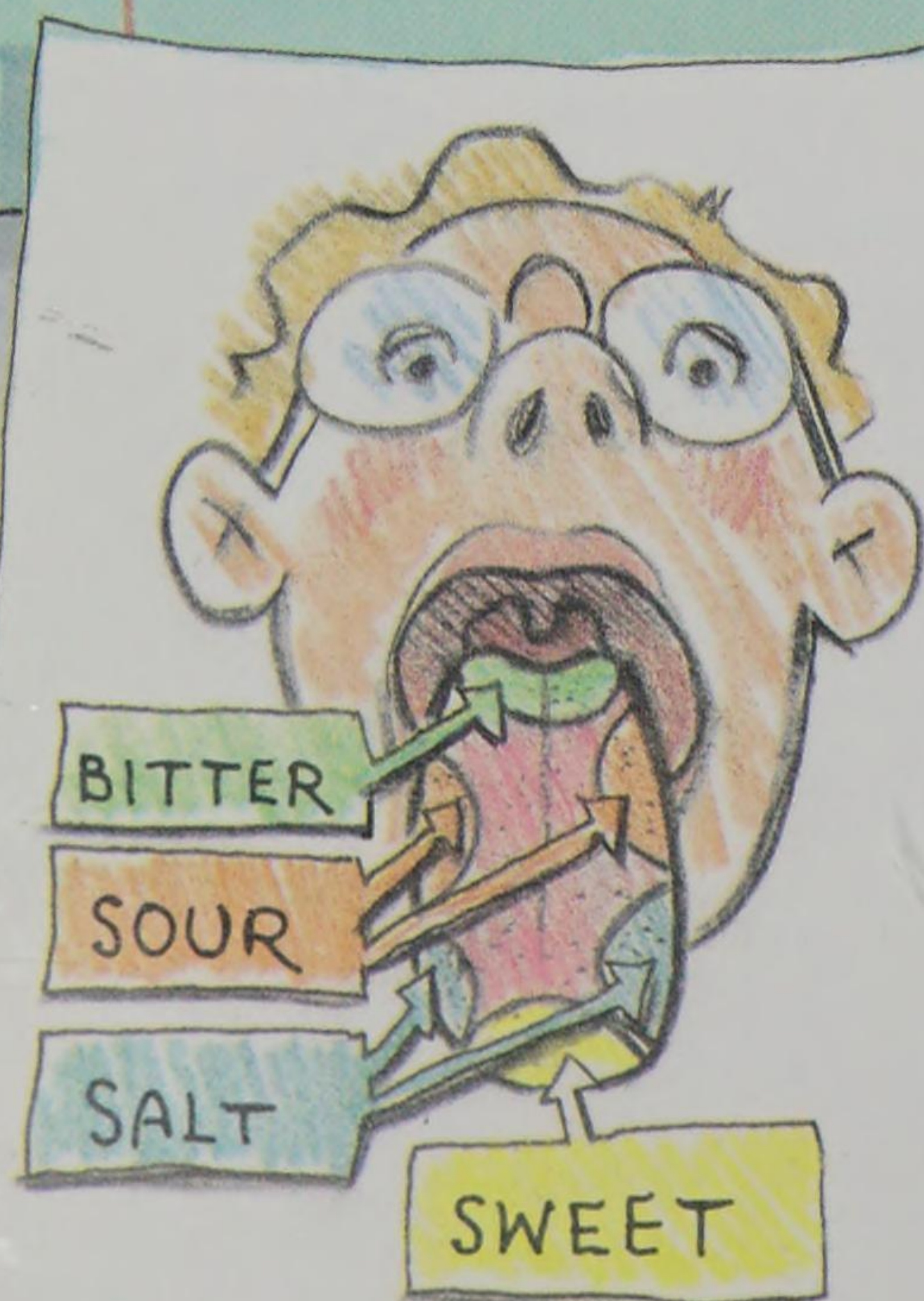




YOUR TONGUE IS  
COVERED WITH THOUSANDS  
OF TASTE BUDS

by Arnold

Different parts of the  
tongue have taste buds  
that detect different  
flavors.



The trip started out like any other trip.  
We rode to the museum  
in the old school bus.  
Along the way,  
we stopped at a park for lunch.

LEFT OVER  
FISH STICKS?!  
ICK!

I'LL TRADE YOU THESE  
TERRIFIC FISH STICKS  
FOR THAT HORRIBLE  
PEANUT BUTTER AND  
BANANA SANDWICH.

FORGET IT!

TAKE A LOOK  
AT HER SHOES.

PLEASE!  
I'M EATING!





When it was time to go,  
everyone got back on the bus—  
everyone but Arnold.  
He was still at the picnic table,  
daydreaming and eating  
a bag of Cheesie-Weesies.

WHEN YOU EAT, YOUR BODY DIGESTS  
THE FOOD SO YOUR CELLS CAN USE IT  
TO MAKE ENERGY.



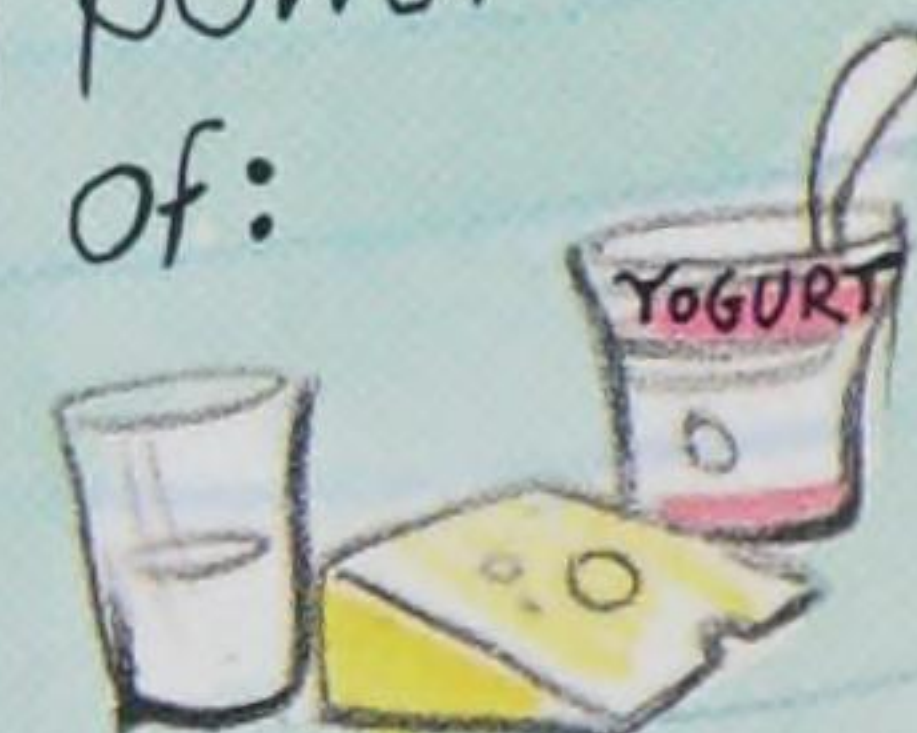
## YOUR BODY NEEDS GOOD FOOD

by Carmen

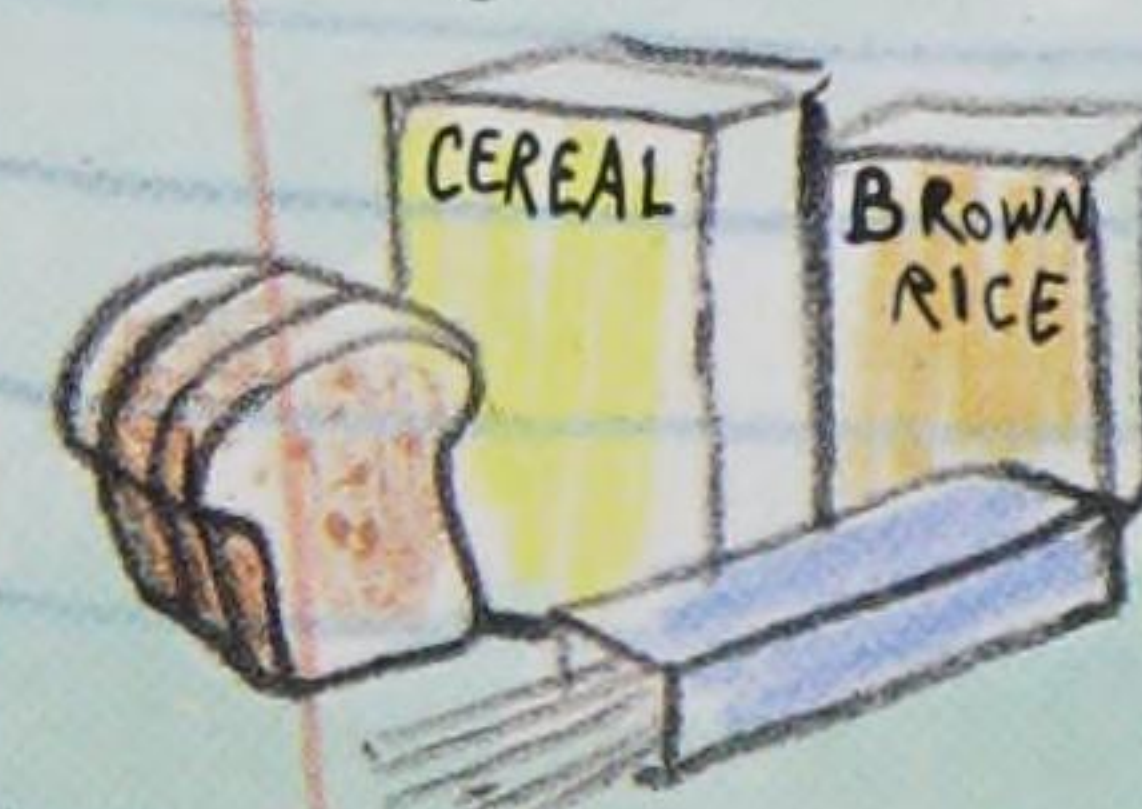
For high energy and  
good growing power  
eat lots of:



Fresh fruits  
and Vegetables



Milk and  
Milk products



Whole grain  
cereal and Pasta



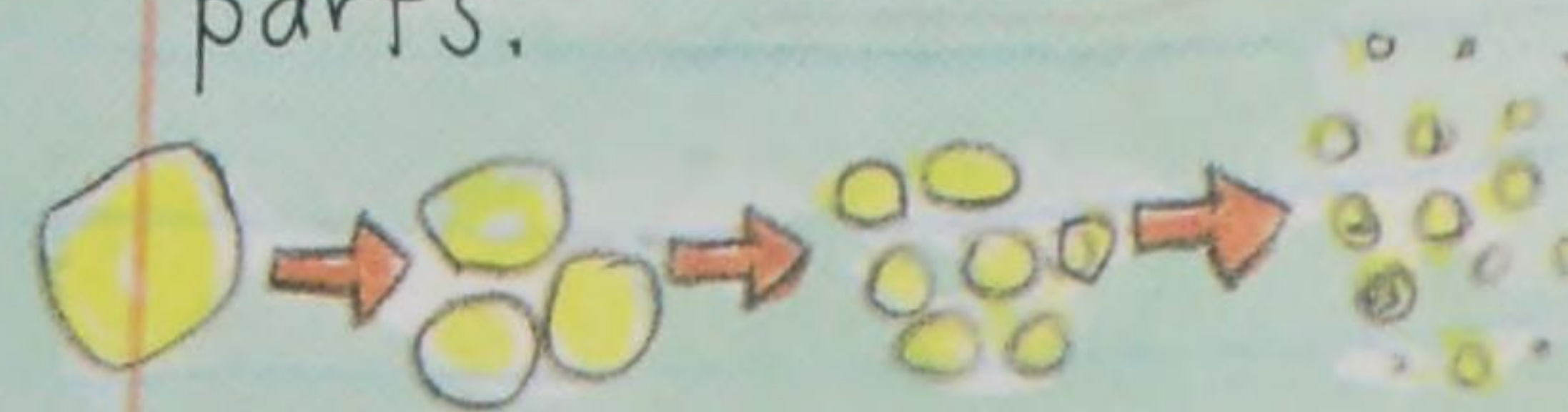
Lean Meats, Fish,  
Poultry, AND eggs

AND NOT TOO MUCH JUNK FOOD

## A SCIENCE WORD

by Dorothy Ann

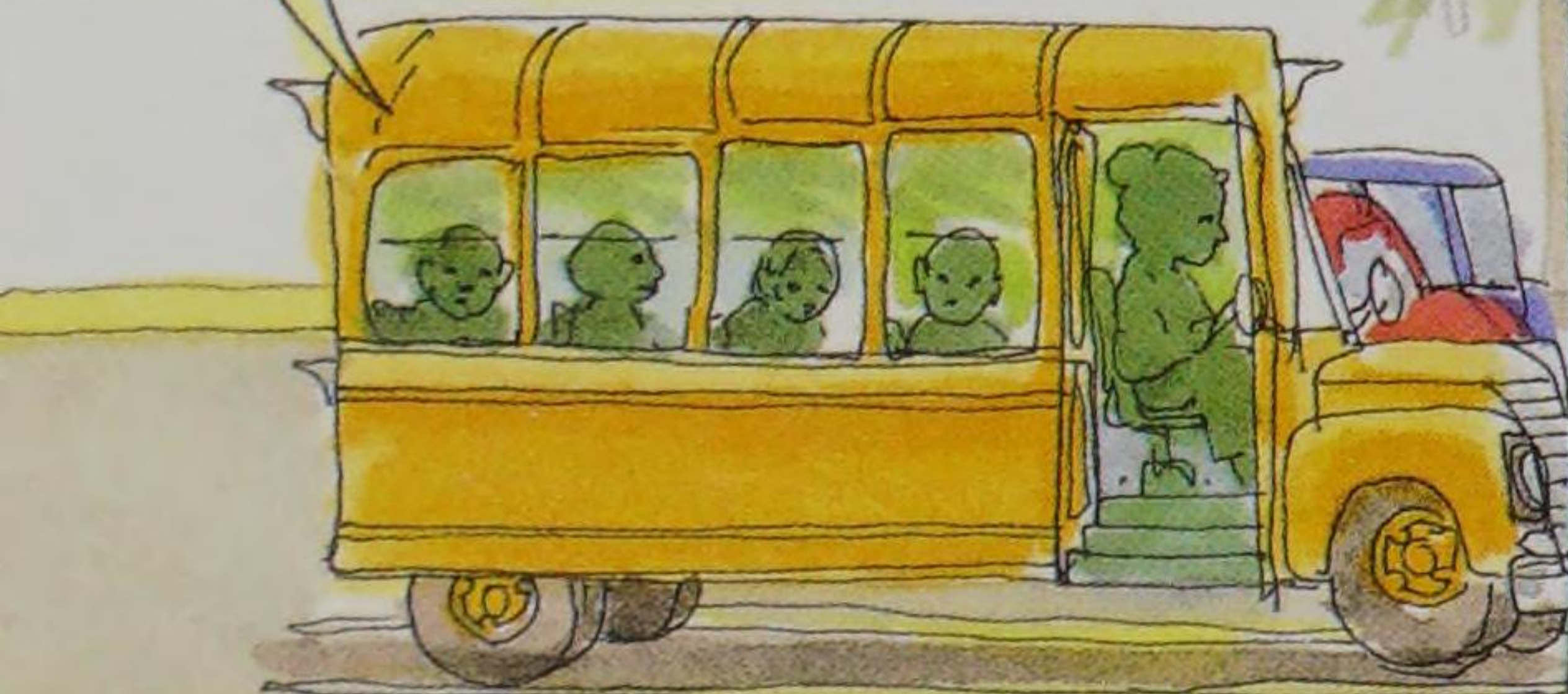
Digestion comes from  
a word that means  
to divide. When food  
is digested it is divided  
into smaller and smaller  
parts.





"Hurry up, Arnold!" called Ms. Frizzle. She reached for the ignition key, but instead she pushed a strange little button nearby.

ARNOLD'S REALLY OUT TO LUNCH.



At once, we started shrinking and spinning through the air.



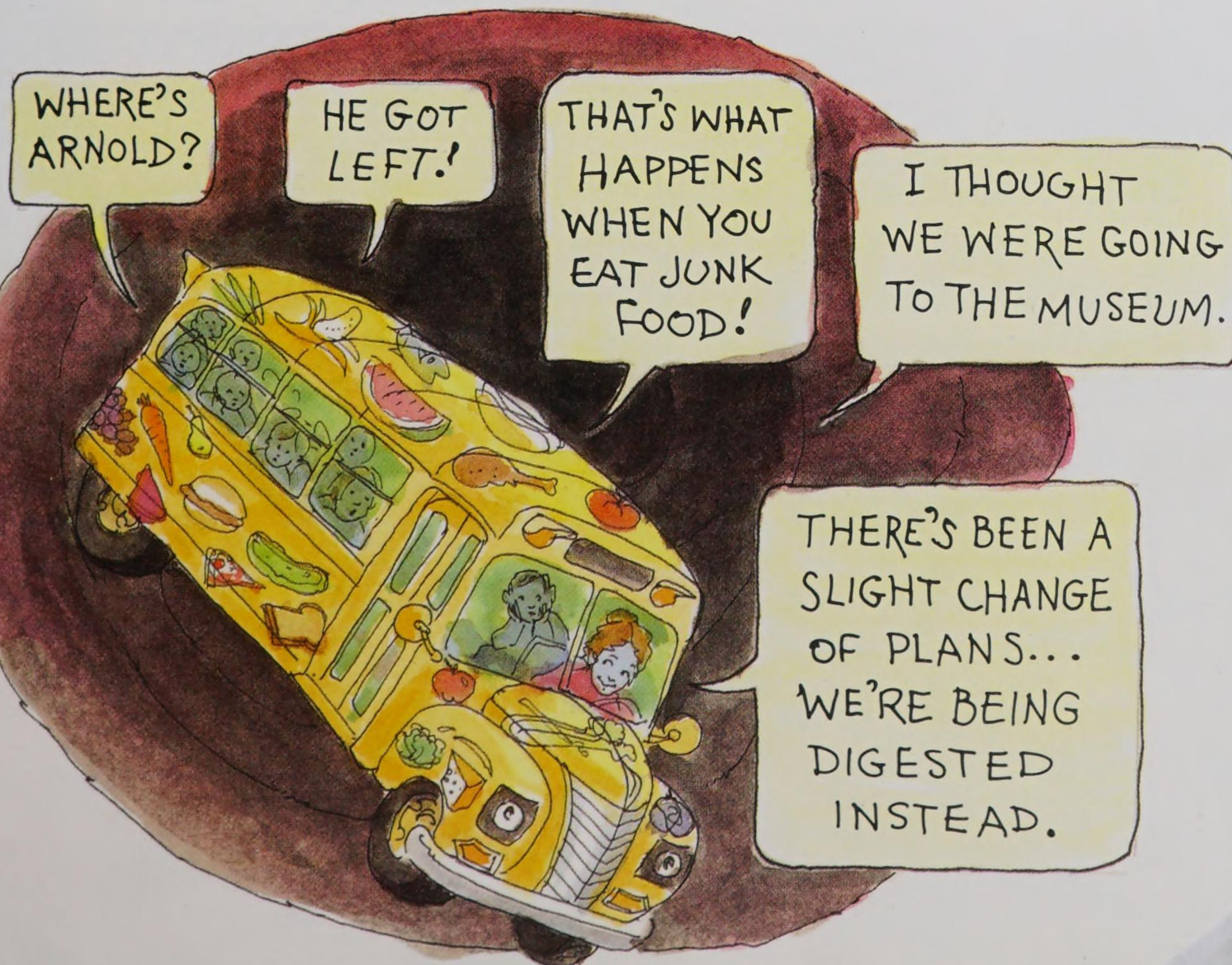
From inside, we couldn't see what was happening. All we knew was that we landed suddenly...

GULPI  
HEY, WHERE'S  
THE BUS?





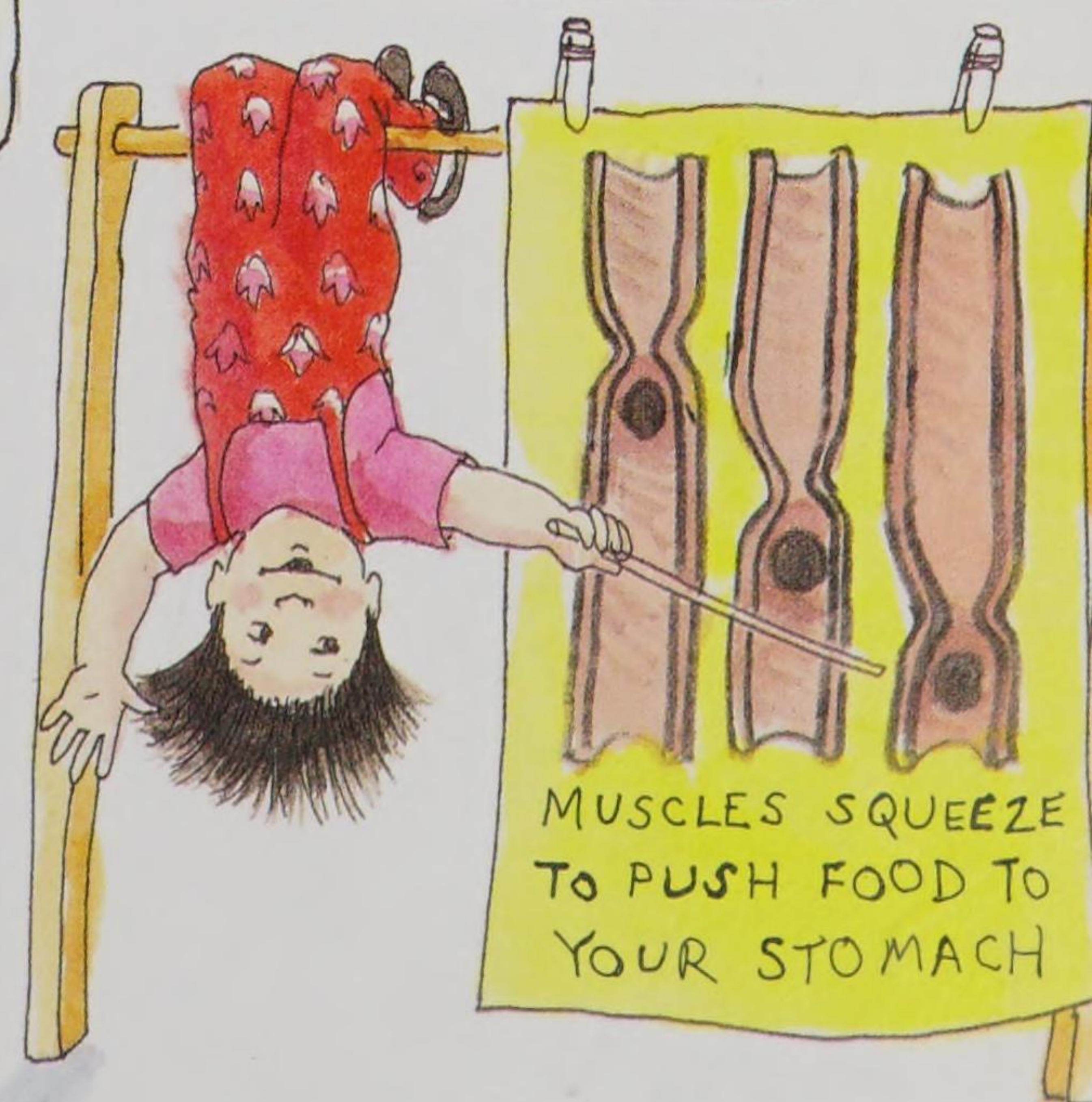
and then we were going down a dark tunnel.  
We had no idea where we were.  
But, as usual, Ms. Frizzle knew.  
She said we were inside a human body,  
going down the esophagus—  
the tube that leads from the throat  
to the stomach.  
Most of us were too upset  
about leaving Arnold behind  
to pay much attention.



## FOOD GOES TO YOUR STOMACH THROUGH THE ESOPHAGUS

by Wanda

The food does not  
just fall down.  
It is pushed along  
by muscle actions  
the way toothpaste  
is squeezed out of  
a tube. That's why  
you can swallow even  
when you are  
upside down.





# WHY DOES YOUR STOMACH GROWL?

by Phil

Sometimes your stomach churns when there is not much food in it. Then the gases in your stomach make a gurgling sound.

"We are now passing into the stomach," said Ms. Frizzle.

It wasn't exactly *quiet* in there.

The walls of the stomach moved in and out, churning and mashing the food into a thick liquid.

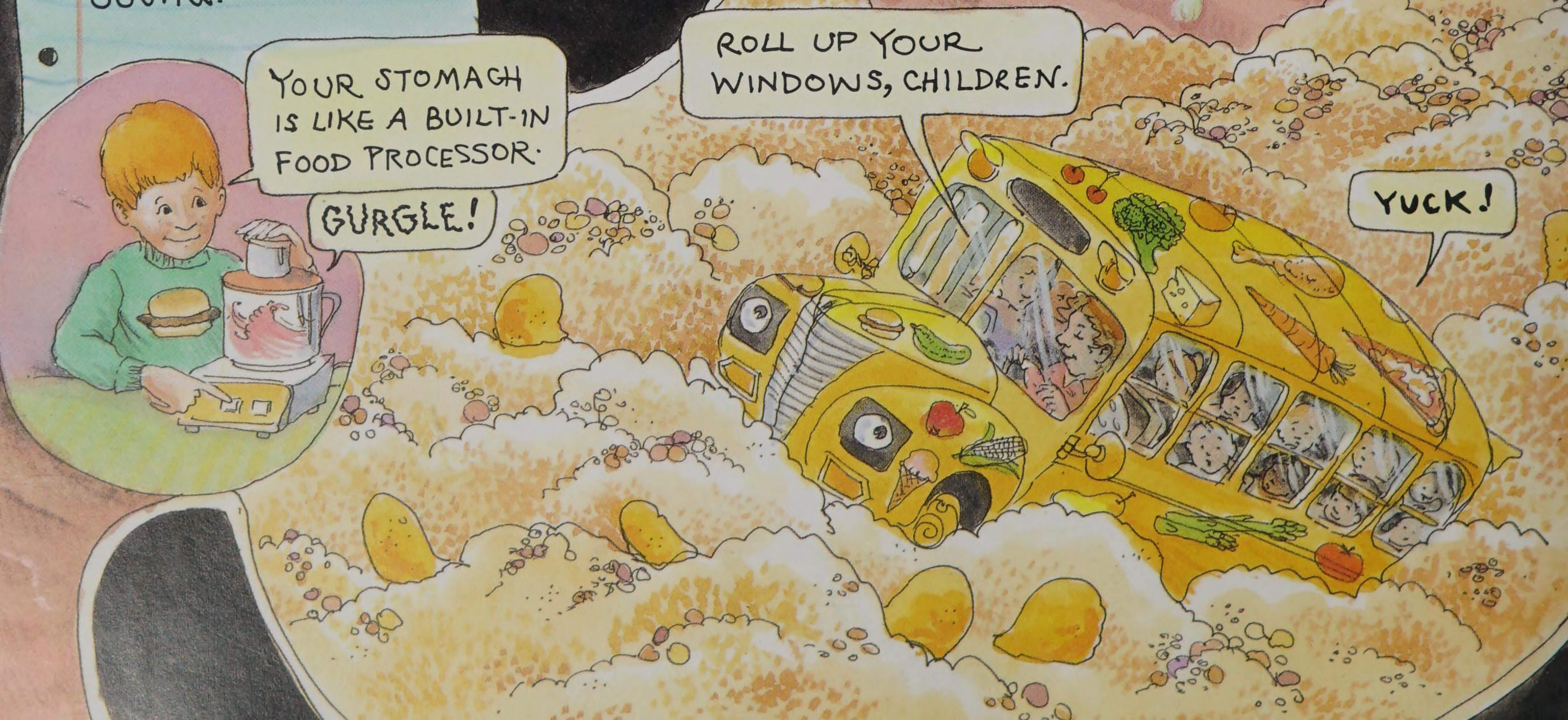
The bus was turning round and round, and digestive juice splashed the windows. Now we knew how it felt to be a hamburger!

YOUR STOMACH IS LIKE A BUILT-IN FOOD PROCESSOR.

GURGLE!

ROLL UP YOUR WINDOWS, CHILDREN.

YUCK!





Ms. Frizzle drove to the bottom of the stomach.  
“We’ll drive through this opening to the small intestine,” she said.

IN THE SMALL INTESTINE, FOOD IS BROKEN DOWN INTO MOLECULES TINY ENOUGH FOR THE BODY CELLS TO USE.

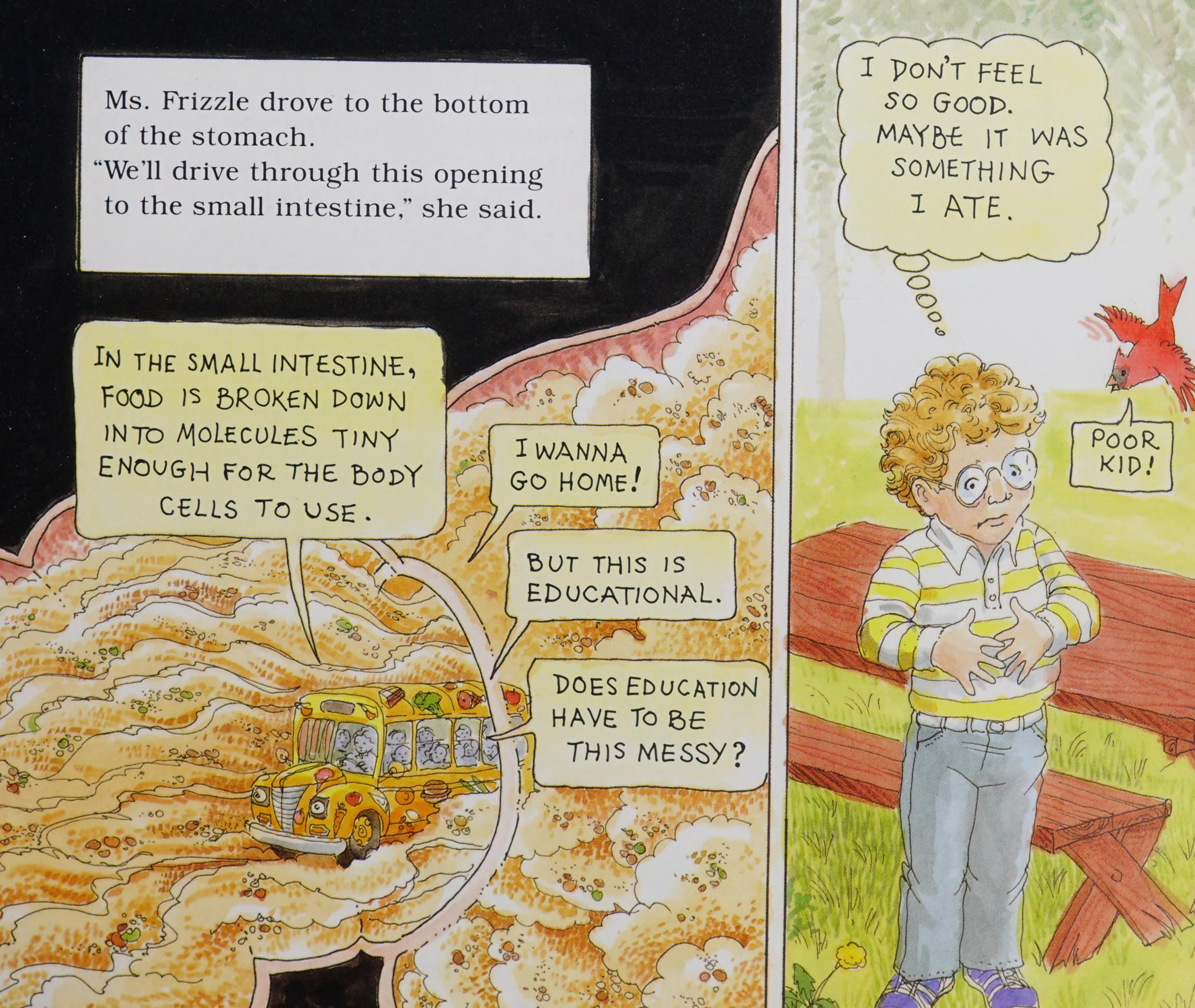
I WANNA GO HOME!

BUT THIS IS EDUCATIONAL.

DOES EDUCATION HAVE TO BE THIS MESSY?

I DON'T FEEL SO GOOD.  
MAYBE IT WAS SOMETHING I ATE.

POOR KID!

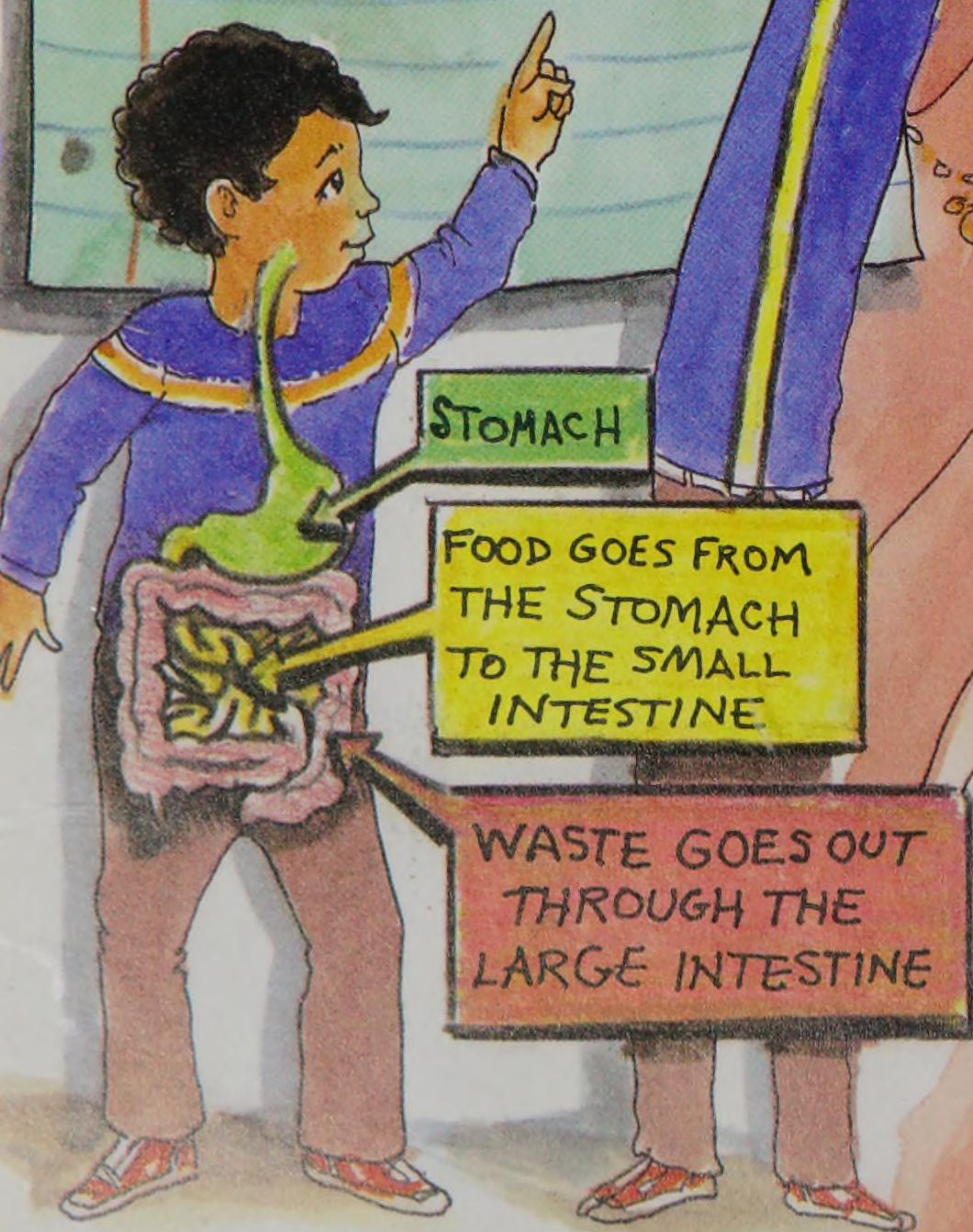




# WHY ARE THE INTESTINES COILED UP?

by John

In an adult the intestines are 7.5 meters (25 feet) long. If they were stretched out straight, a person would have to be as tall as a house.



The small intestine was a coiled-up hollow tube.

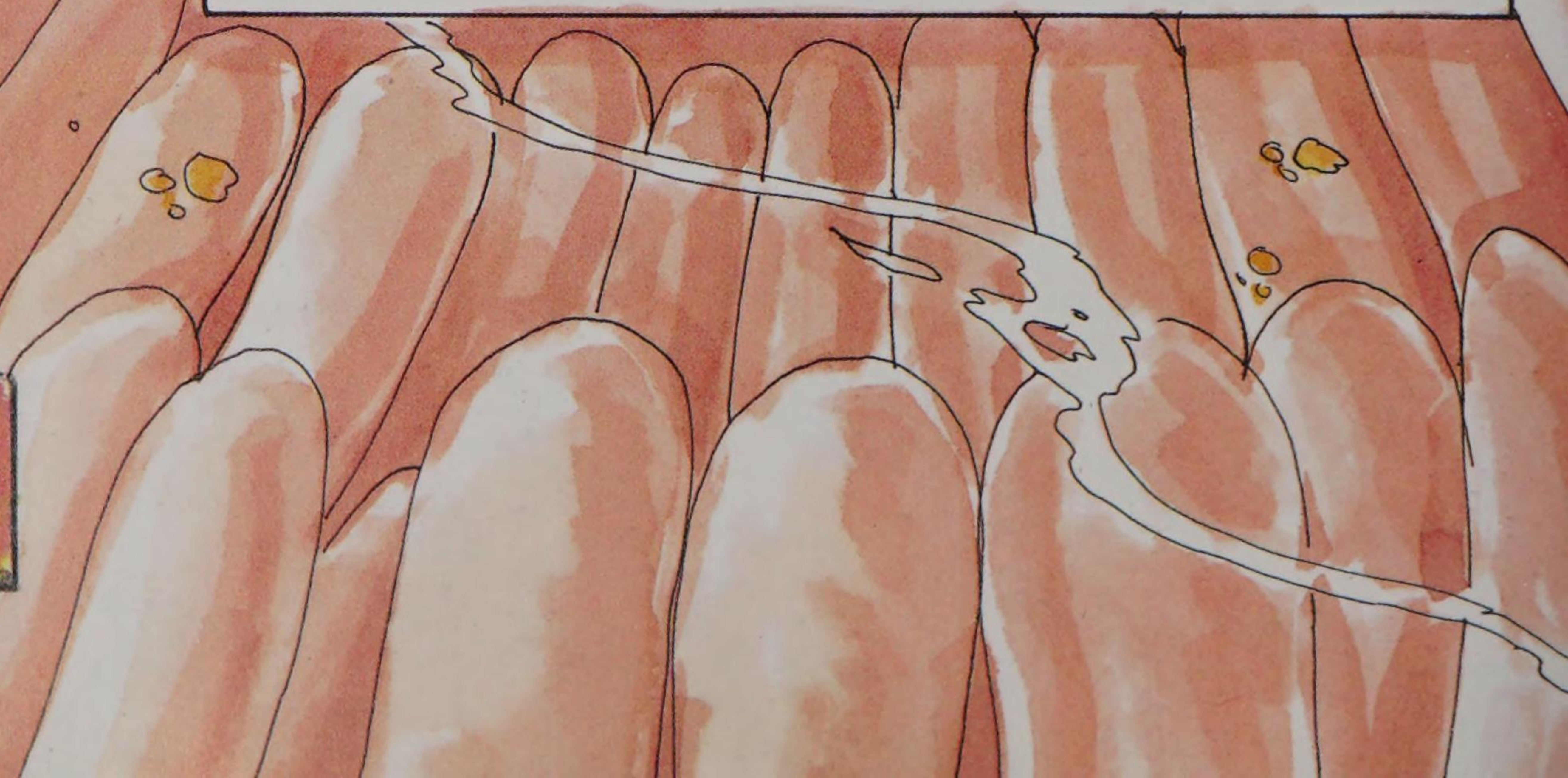
The inner walls of the tube were covered with tiny “fingers” called *villi*.

“In the *villi* are tiny blood vessels. Food molecules are taken into these blood vessels,” said Ms. Frizzle.

“Once the food is in the blood, it can travel all over the body.”

We felt ourselves getting even smaller, and Ms. Frizzle started driving into one of the *villi*.

She was going straight into a blood vessel!





CLASS, THE BUS IS  
FOLLOWING THE PATH  
OF THE FOOD MOLECULES  
INTO THE BLOOD.

YOU MEAN THIS BODY  
THINKS WE'RE FOOD?

THAT'S BETTER  
THAN BEING WASTE.

YEAH!  
IT'S SO GROSS!

I WISH ARNOLD  
WERE HERE  
TO SEE THIS.

• ANOTHER SCIENCE WORD  
by Dorothy Ann

Blood Vessels are  
tubes that carry  
blood. They are  
like pipelines  
running through  
your body.





## WHAT IS BLOOD MADE OF?

by Molly

A little more than half the blood is a yellowish fluid called PLASMA.

The rest of the blood is made of floating cells.



PLASMA

BLOOD CELLS

250,000,000

## WHY IS BLOOD RED?

by Shirley

Without a microscope, blood looks red because there are so many red blood cells in it! In every drop of blood there are 250 million red blood cells.

RED BLOOD CELLS CARRY OXYGEN

FOOD MOLECULES



WHITE BLOOD CELLS

Now we were in the blood, but it did not look red.

"Blood is not just a red liquid," explained Ms. Frizzle.

"Blood is made of cells, floating in a clear fluid."

"Those cells look like red rubber saucers!" someone called out.

"Those are red blood cells," Ms. Frizzle said.

"Red blood cells carry oxygen from the lungs to all the cells of the body."

DID YOU SEE THAT?



Here and there a white blood cell was busy destroying disease germs. "White blood cells are like soldiers protecting your body from enemies," said Ms. Frizzle.

THE WHITE BLOOD CELL ATE THE GERM.

THAT'S DISGUSTING!

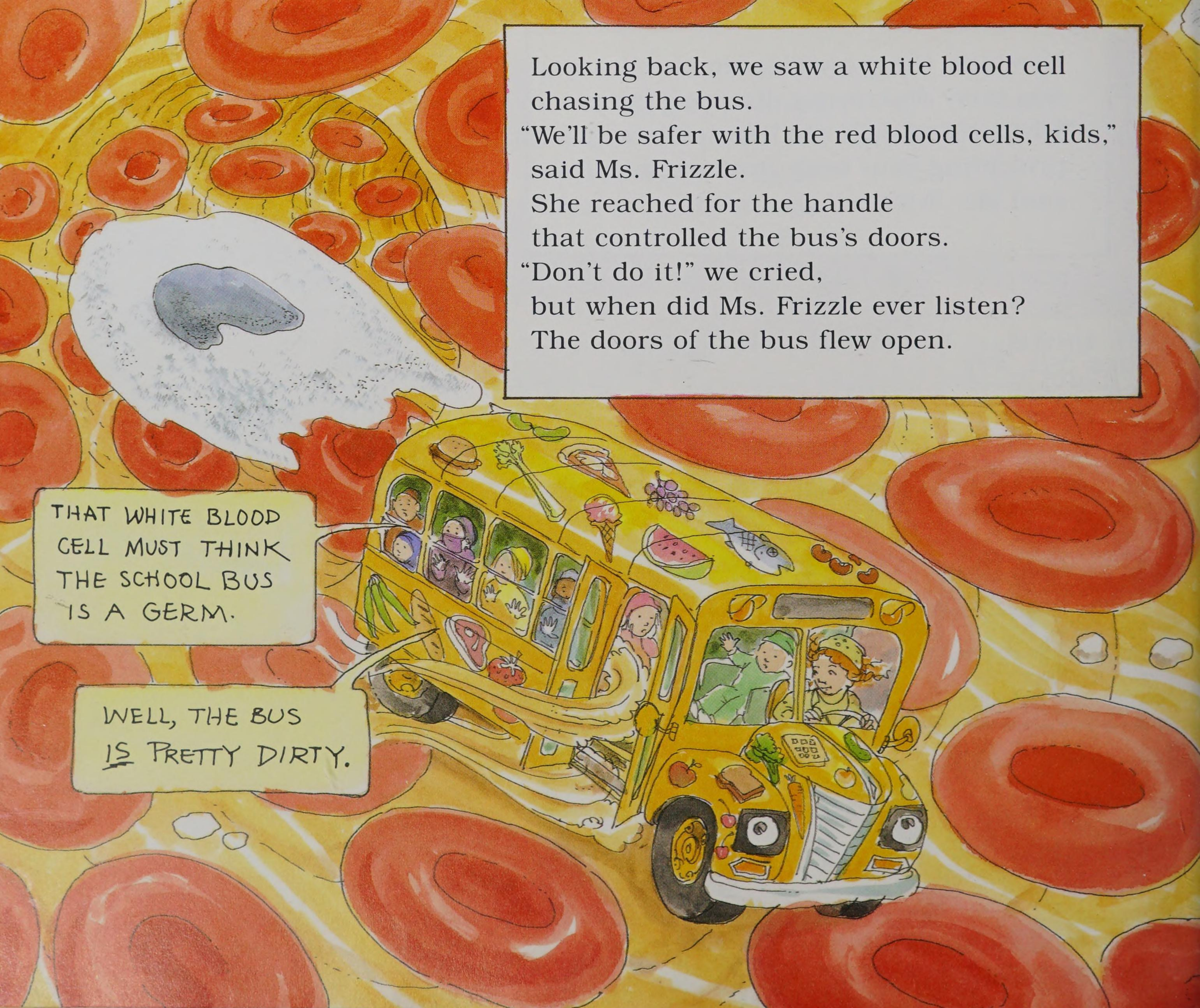
PLATELET CELLS  
(HELP STOP BLEEDING  
WHEN YOU GET A CUT)

DISEASE GERMS

WHAT IS BLOOD FOR?  
by Ralph  
Your blood is like a delivery service. It carries food and oxygen to your body's cells and waste products away from the cells.







Looking back, we saw a white blood cell chasing the bus.

"We'll be safer with the red blood cells, kids," said Ms. Frizzle.

She reached for the handle that controlled the bus's doors.

"Don't do it!" we cried, but when did Ms. Frizzle ever listen? The doors of the bus flew open.

THAT WHITE BLOOD CELL MUST THINK THE SCHOOL BUS IS A GERM.

WELL, THE BUS IS PRETTY DIRTY.



We were swept out of the bus and into the bloodstream. "Everybody hitch a ride!" called The Friz. Each kid grabbed a red blood cell as it went by. Our last glimpse of the bus was when it went into another blood vessel—with the white blood cell right behind it!

WHY CAN'T WE JUST HAVE SPELLING TESTS LIKE OTHER KIDS?

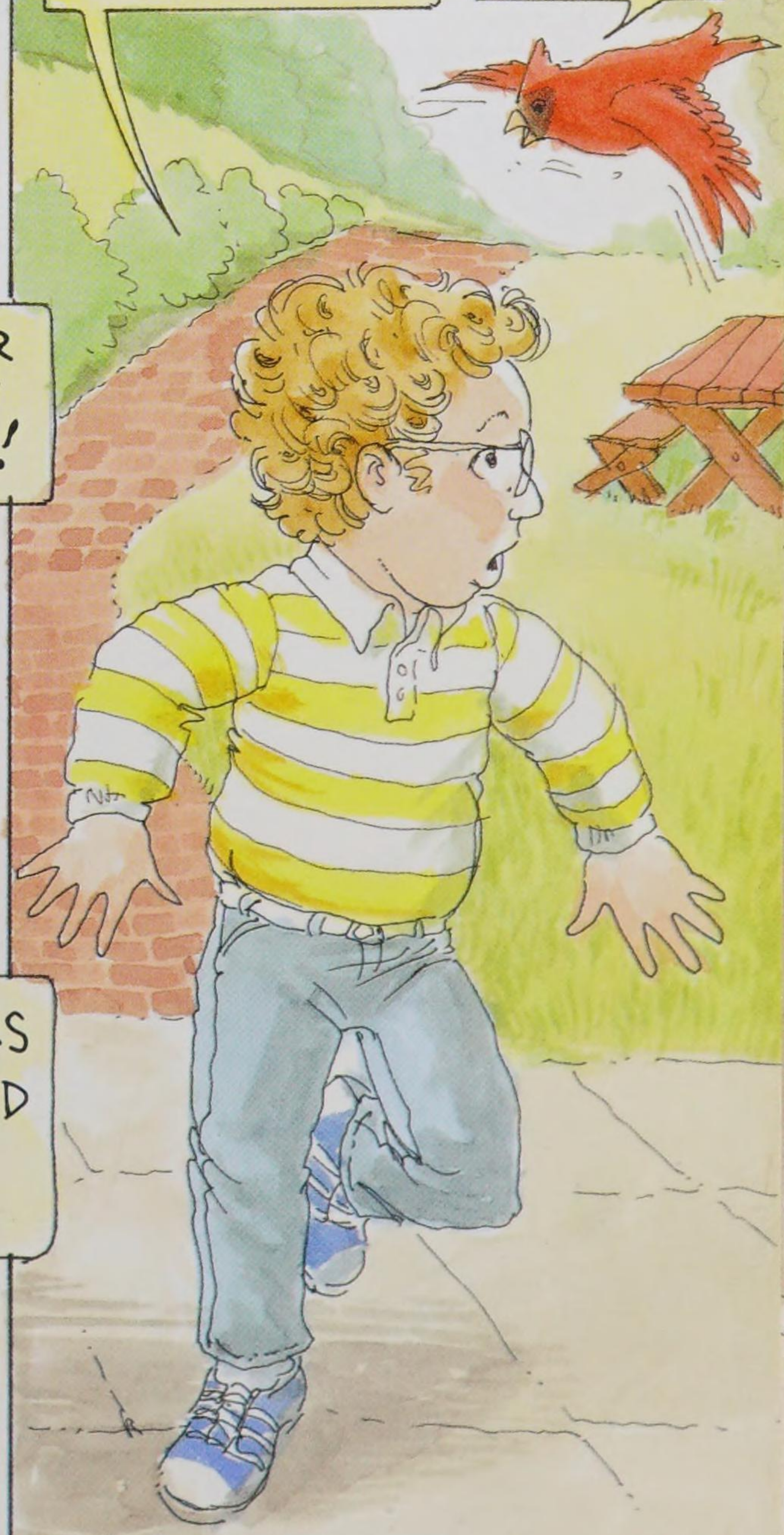
WE'LL NEVER GET OUT OF HERE NOW!

THESE RED BLOOD CELLS HAVE TURNED DULL RED — THEY NEED MORE OXYGEN.

MEANWHILE...

OH MY GOSH! I'M LOST!

DON'T PANIC





# YOUR HEART IS A PUMP by Florrie

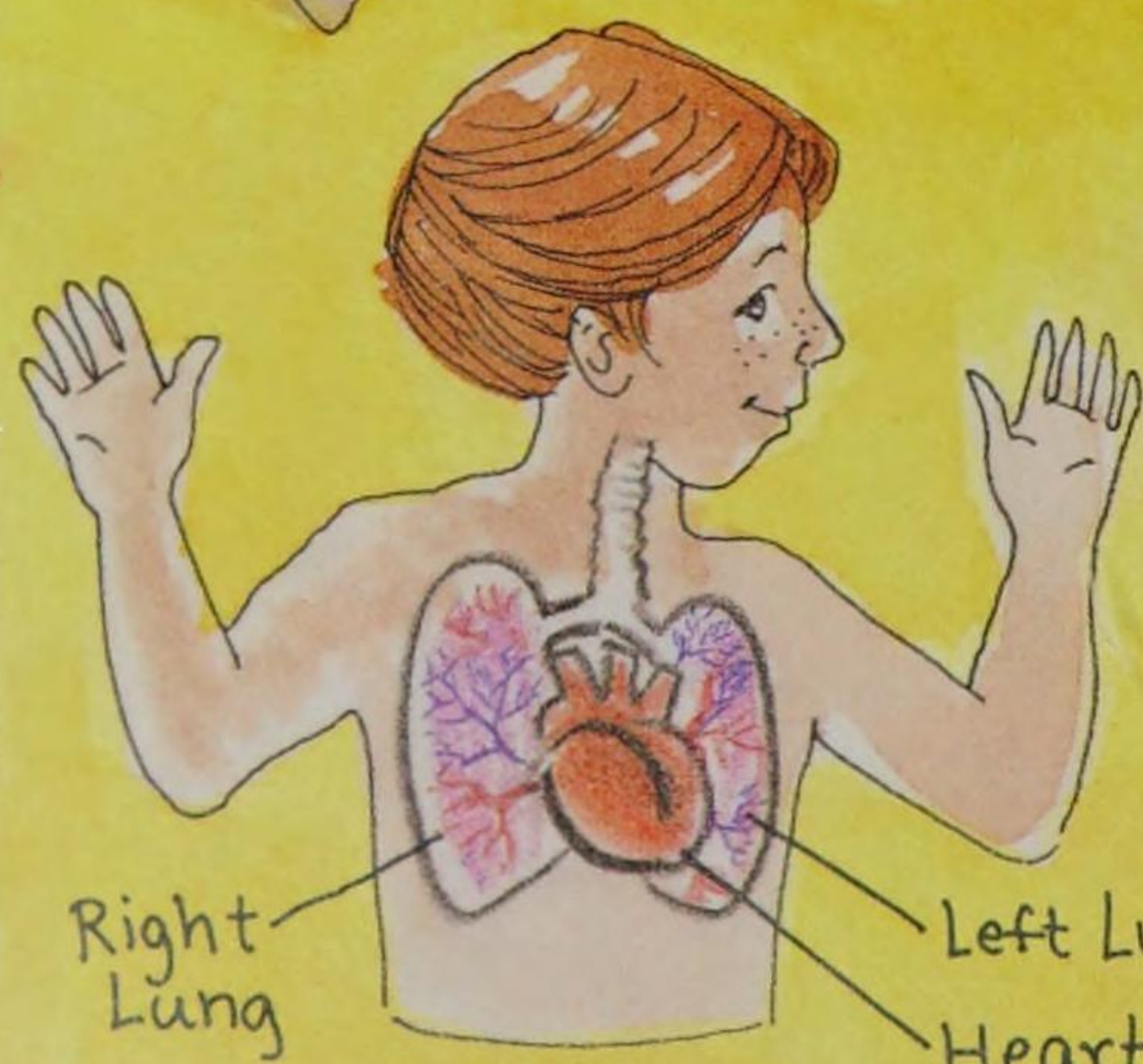
When the walls of the heart chambers squeeze together they pump out blood, just the way you can squeeze water out of a plastic squeeze bottle.

RIGHT LUNG

The next thing we knew, we had flowed into the heart. "Inside the heart are four hollow spaces, called *chambers*," said Ms. F. "Each chamber is a little pump." The two chambers on the right side of the heart took in used blood from the body and pumped it to the lungs.

OOPS!

HEY!



Right Lung

Left Lung  
Heart

YOUR HEART PUMPS  
USED BLOOD INTO THE LUNGS  
TO GET FRESH OXYGEN.

1<sup>st</sup> CHAMBER

HAVE A HEART,  
MS. FRIZZLE,  
GET US OUT  
OF HERE!

USED BLOOD  
FROM LOWER  
BODY

2<sup>nd</sup> CHAMBER

USED BLOOD  
FROM UPPER  
BODY

TO THE RIGHT LUNG



In the lungs, the red cells  
picked up fresh oxygen.

WE GET NEW OXYGEN  
FROM THE AIR EACH  
TIME WE BREATHE IN.

WE GET RID OF A WASTE  
GAS—CARBON DIOXIDE—  
EACH TIME WE BREATHE  
OUT.

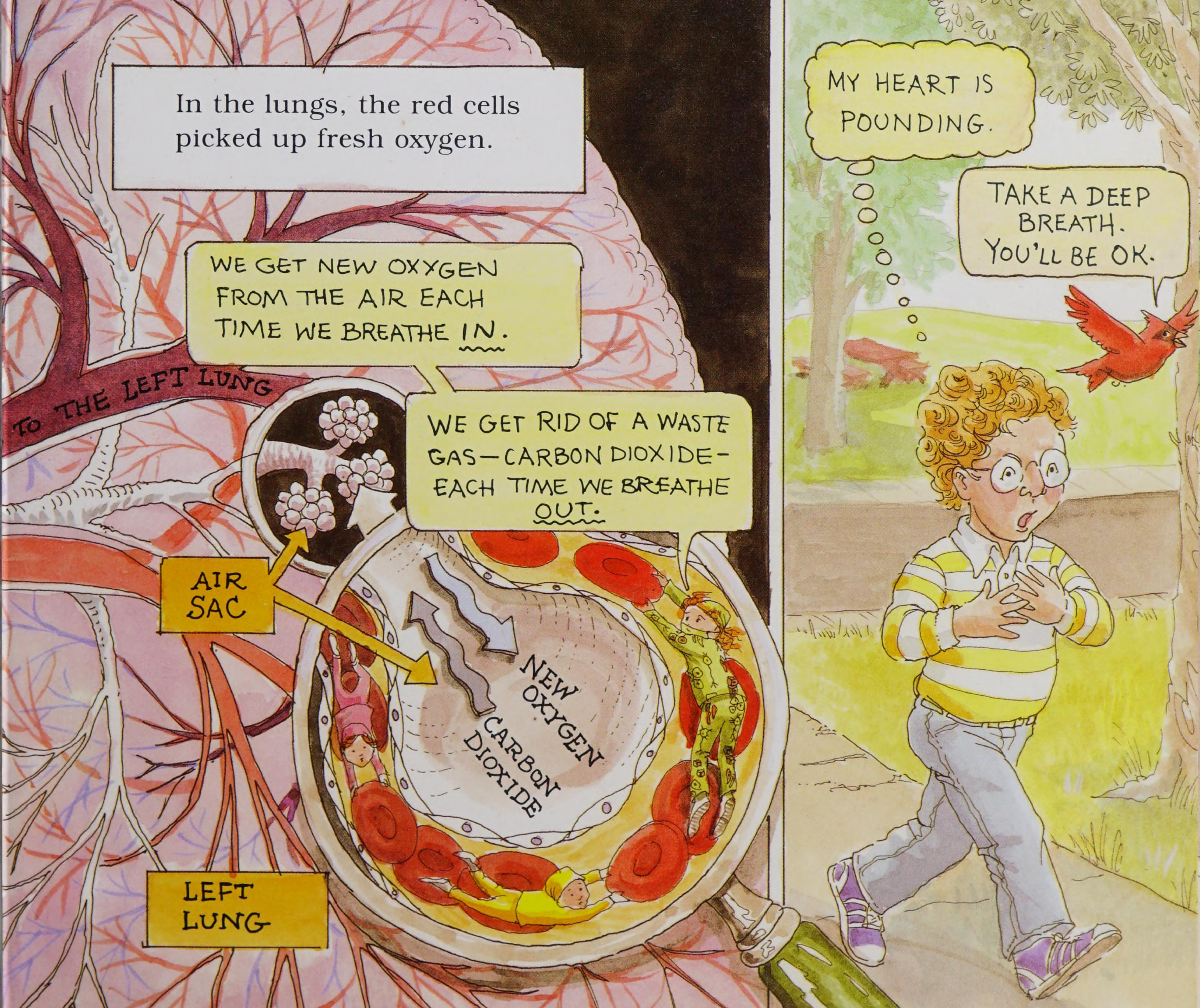
AIR  
SAC

LEFT  
LUNG

NEW  
OXYGEN  
CARBON  
DIOXIDE

MY HEART IS  
POUNDING.

TAKE A DEEP  
BREATH.  
YOU'LL BE OK.





BLOOD GOES ROUND  
AND ROUND

by Michael

In less than a minute  
your blood makes  
a trip all around  
your body.

This is called the  
circulation of the  
blood.

From the lungs, our red blood cells  
carried us back to the heart.

This time we were on the left side  
of the heart—the side that pumps  
fresh blood back to the body again.

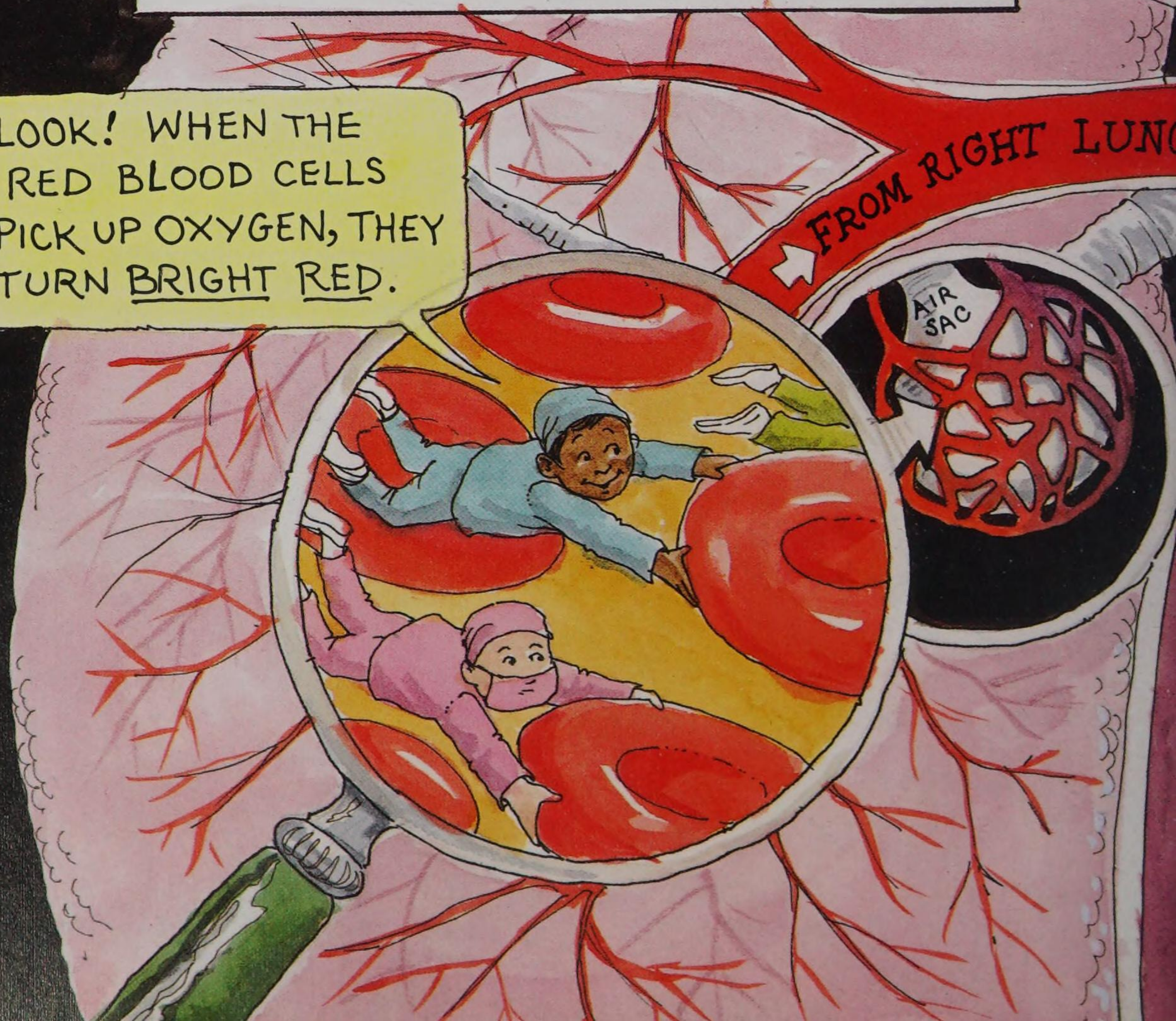
“Kids, it looks as if these red  
blood cells are on their way to  
the brain,” said Ms. Frizzle.

LOOK! WHEN THE  
RED BLOOD CELLS  
PICK UP OXYGEN, THEY  
TURN BRIGHT RED.

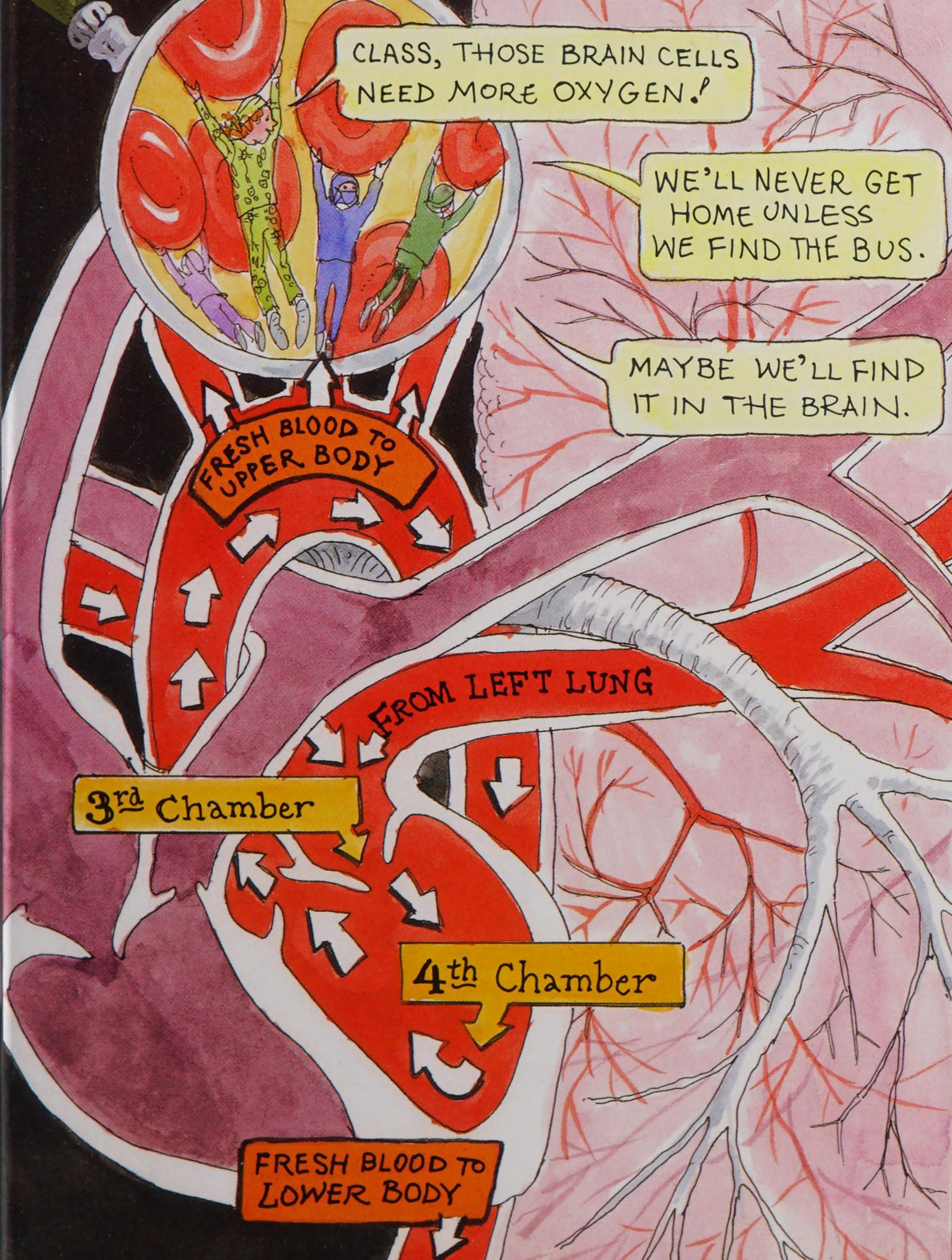
ONE MORE SCIENCE WORD

by Dorothy Ann

Circulate comes from  
a word that means  
“to circle”. Blood  
circulates - circles -  
all around your body.









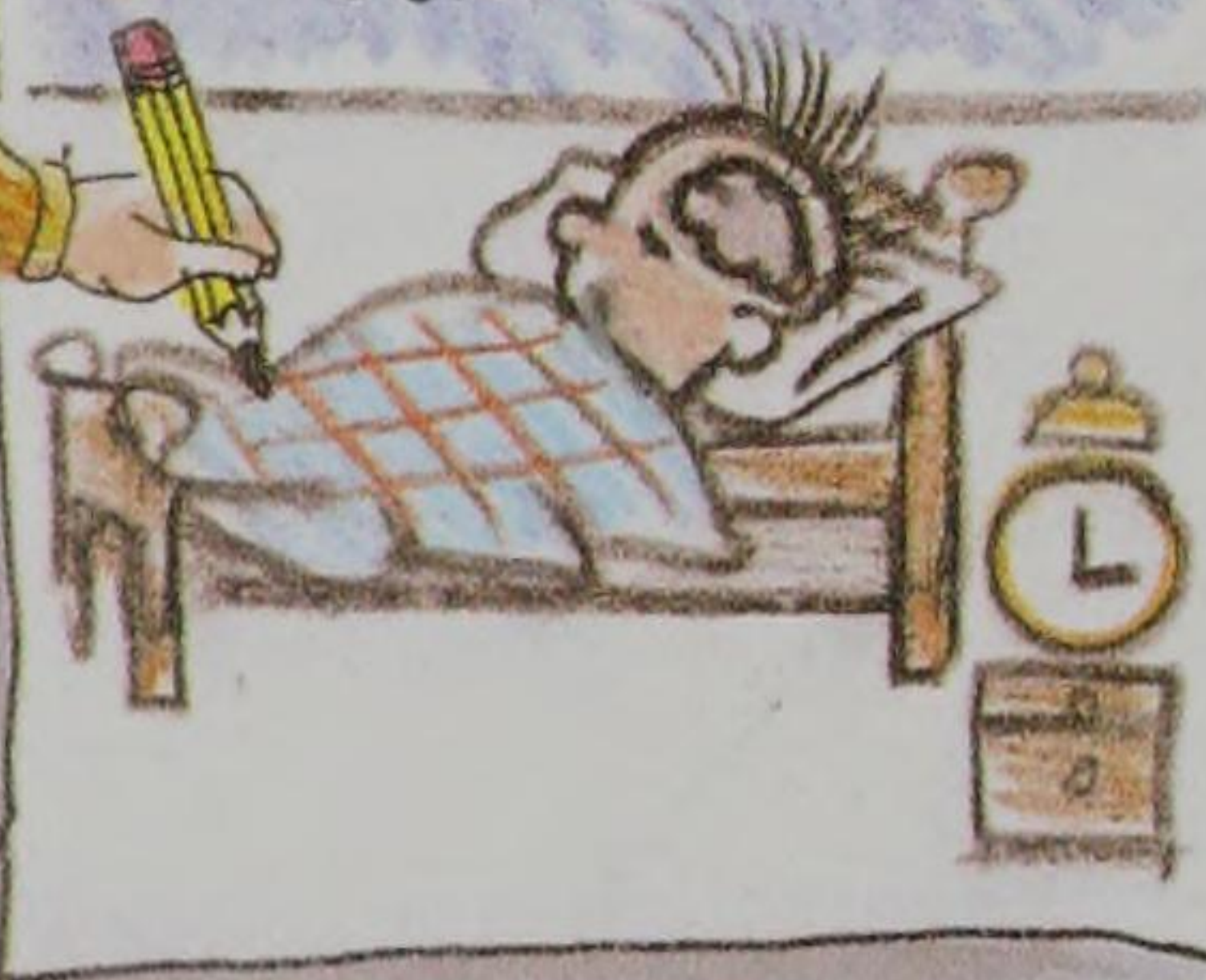
- YOUR BRAIN IS ALWAYS WORKING by Alex
- Even when you're sleeping, your brain controls your heartbeat, breathing, and other body functions.

When we reached the brain, we let go of our red blood cells and squeezed out of the blood vessel. It was hard to believe that this wrinkled gray blob was the control center of the body.

CHILDREN, WE ARE WALKING ON THE CEREBRAL CORTEX, THE PINKISH GRAY, OUTER LAYER OF THE BRAIN. WITHOUT IT WE COULDN'T SEE, HEAR, SMELL, TOUCH, TASTE, TALK, MOVE, OR THINK!

YOUR BRAIN NEVER LIES DOWN ON THE JOB.

3:00 A.M. and still at it.



CEREBRAL CORTEX  
Controls thinking, moving and the five Senses.

SPEECH CENTER

HEARING CENTER

MOTOR CENTER  
TELLS MUSCLES TO MOVE





Ms. Frizzle said  
the brain is made of  
billions of busy nerve cells.  
They are constantly sending  
and receiving messages  
from the eyes, ears, muscles,  
and other parts of the body.



TOUCH  
CENTER

WHERE'S  
THE BUS?

DO YOU THINK  
WE'LL BE SMARTER  
AFTER THIS?

I HOPE  
SO!

VISION  
CENTER

CEREBELLUM:

Helps you keep your  
balance, Helps muscles  
work together.

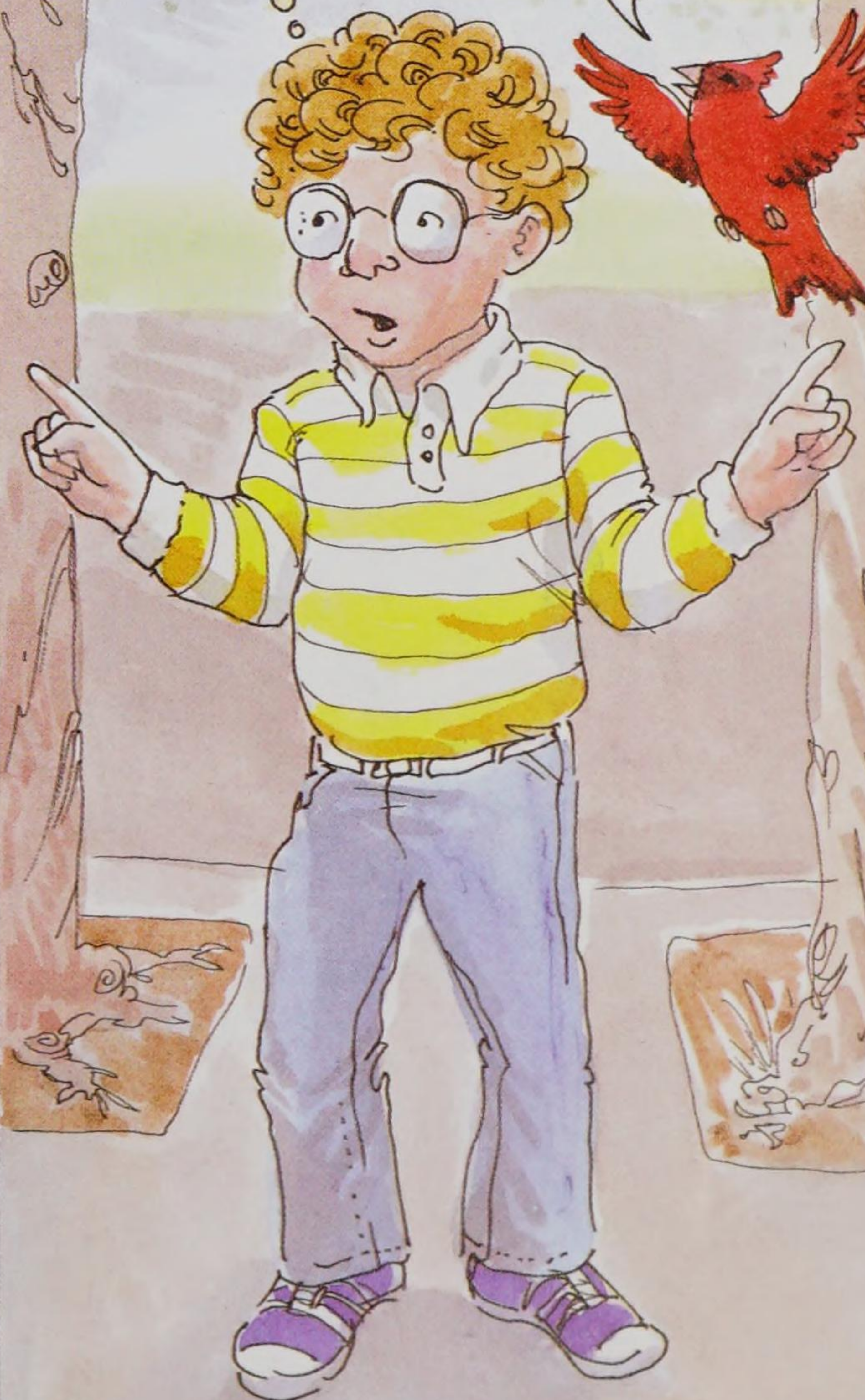
BRAIN STEM:

Controls body functions  
like heartbeat and  
breathing.

LET'S SEE...

MS. FRIZZLE WAS  
DRIVING THAT WAY  
TO THE MUSEUM,  
SO OUR SCHOOL  
MUST BE THIS WAY.

GOOD THINKING.





IF YOU WANT TO  
MOVE A MUSCLE  
by Amanda Jane

- The motor area (in the cortex) of your brain sends out a message to move.
- The message travels down the spinal cord and through the nerves that control the muscles.
- 

We left the head by climbing down the bones of the spine.

Inside the bones was the spinal cord—a thick bundle of nerve cells stretching from the brain.

Smaller bundles of nerve cells branched out from each side of the spinal cord.

These carried nerve messages to all the parts of the body.

THE SPINAL CORD  
CONNECTS THE  
BRAIN WITH THE  
NERVES THAT GO  
TO THE BODY.

DON'T LOOK  
DOWN!

I THINK I'M LOSING  
MY NERVE!

MOTOR AREA

HEY! THAT  
TICKLES!

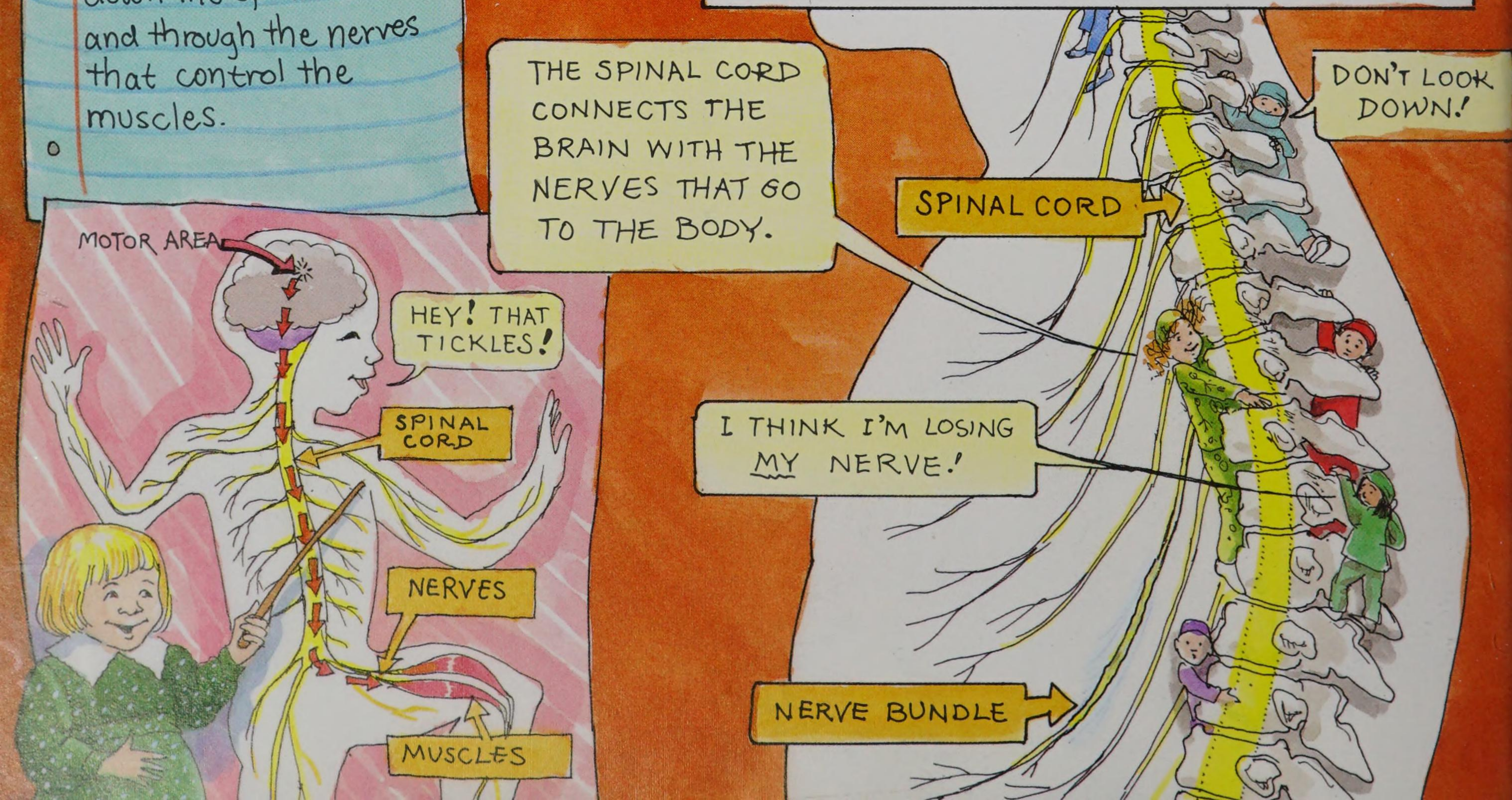
SPINAL  
CORD

NERVES

MUSCLES

SPINAL CORD

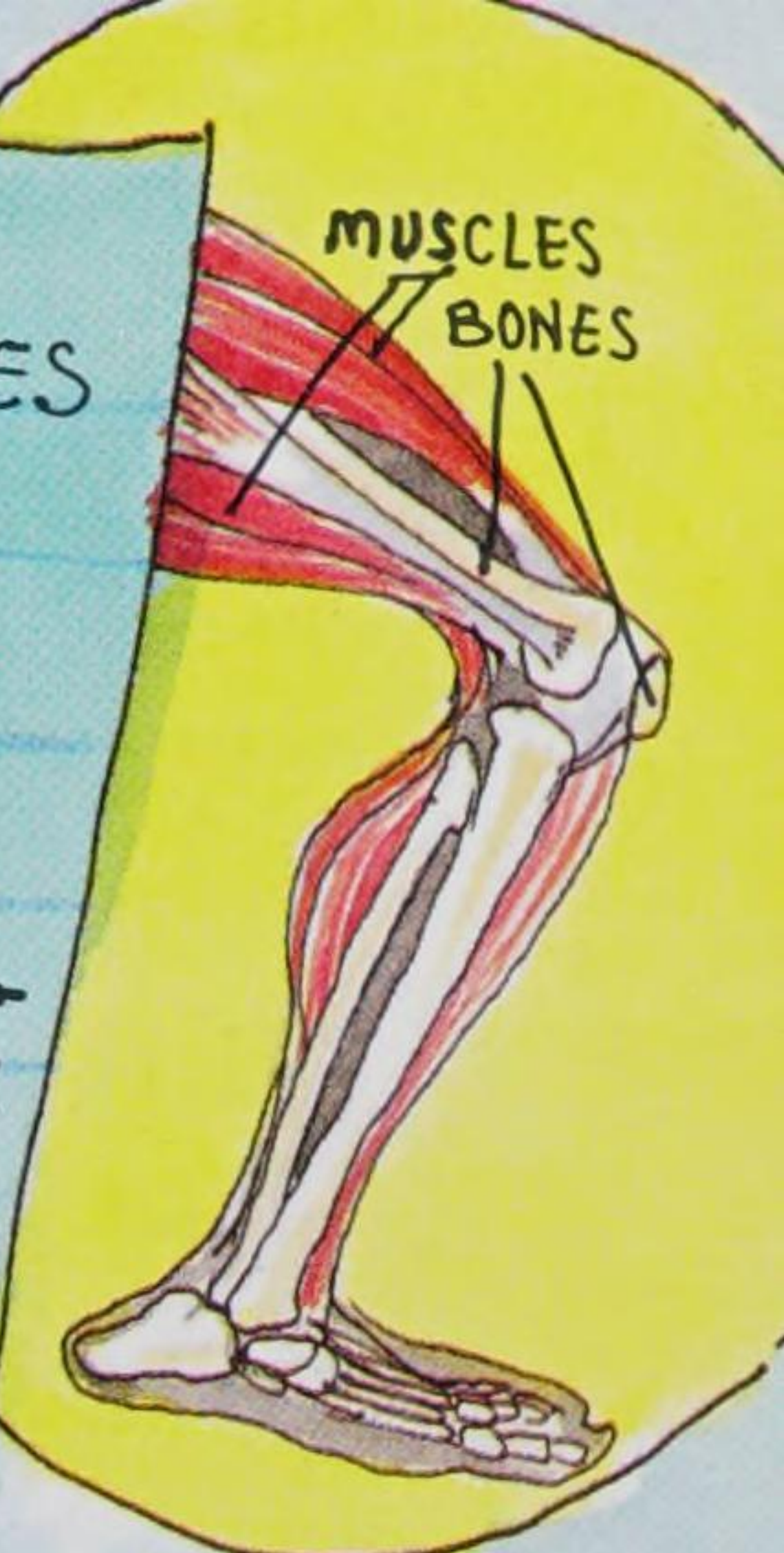
NERVE BUNDLE





We followed some nerves that went to the leg muscles. The leg muscles were working hard. They needed a lot of energy. They used up a lot of food and oxygen from the blood. The heart was beating faster to carry fresh blood to the muscle cells.

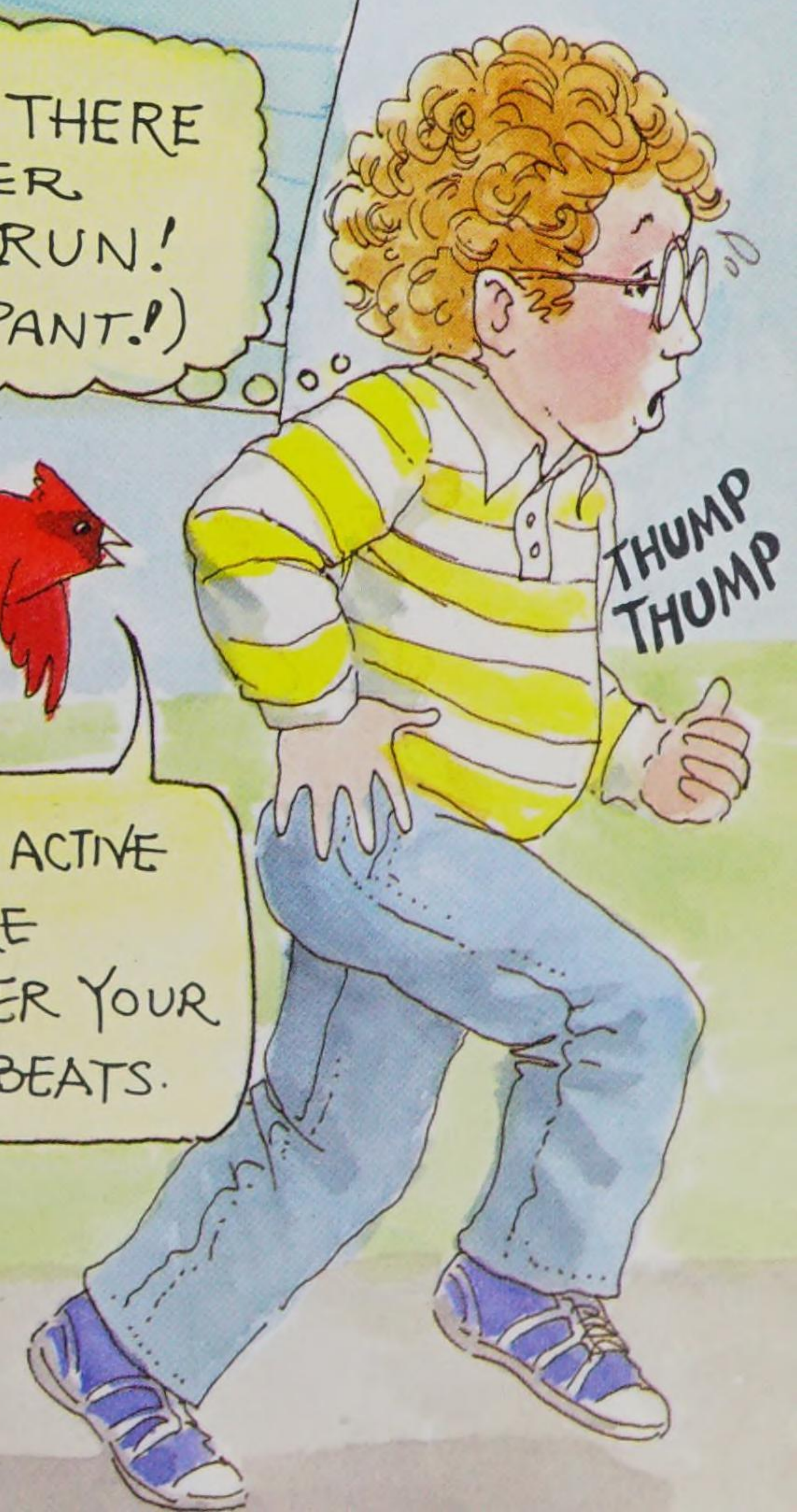
MUSCLES MOVE YOUR BONES by Tim  
Some muscles are attached to bones. When the muscles contract (get shorter) they pull on the bones. That makes the bones move, and then you move.



I'LL GET THERE SOONER IF I RUN! (PANT! PANT!)

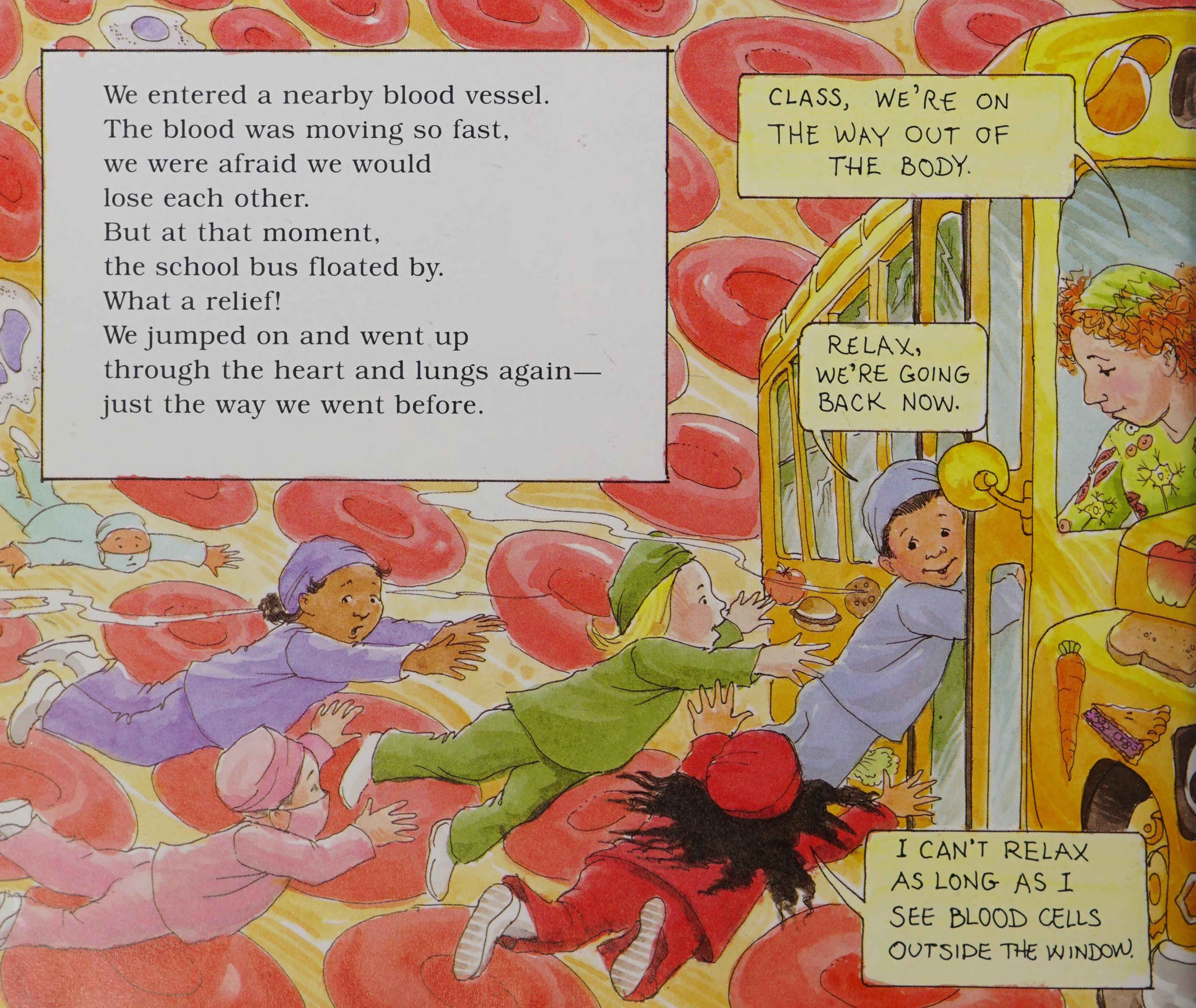


THE MORE ACTIVE YOU ARE THE FASTER YOUR HEART BEATS.





We entered a nearby blood vessel.  
The blood was moving so fast,  
we were afraid we would  
lose each other.  
But at that moment,  
the school bus floated by.  
What a relief!  
We jumped on and went up  
through the heart and lungs again—  
just the way we went before.



CLASS, WE'RE ON  
THE WAY OUT OF  
THE BODY.

RELAX,  
WE'RE GOING  
BACK NOW.

I CAN'T RELAX  
AS LONG AS I  
SEE BLOOD CELLS  
OUTSIDE THE WINDOW.



When we emerged from the bloodsteam,  
we were in a huge open space.

"Where are we?" asked a kid.

Ms. Frizzle explained,

"Children, this is the nasal cavity."

"The what?" we asked.

"The inside of the nose," said The Friz.

Suddenly, we heard a deafening noise.

It sounded like "Ah-aa-aa-ah!"

WE'RE IN  
A NOSE?

THIS TIME  
SHE'S GONE  
TOO FAR.

I AM SO  
GROSSED OUT!



I THINK I'M  
GOING TO  
SNEEZE...

USE YOUR  
HANKIE.





# WHAT MAKES YOU SNEEZE?

by Phoebe

If something is tickling the inside of your nose, the tickling signals your brain.

- The brain makes you take an extra big breath. (That's when you say Aaah!)

Then your brain makes your chest muscles

- squeeze your lungs.

Air rushes out at speeds of up to 100 miles per hour. (That's when you say choo!)



Then we heard,  
"CHOOOOOOO!"

CLASS, THE SOUND  
YOU HEAR IS A SNEEZE.

ANYTHING IN THE NOSE  
CAN MAKE YOU SNEEZE.  
IT COULD BE A BIT  
OF DIRT OR DUST,  
OR SOME BACTERIA.

IN THIS CASE  
IT HAPPENS  
TO BE A  
SCHOOL BUS.





A tremendous blast of air  
hit the bus full force.  
We flew forward,  
spinning around and around.

CHILDREN, PREPARE  
FOR LANDING.  
PLEASE REMAIN SEATED  
UNTIL THE SCHOOL BUS  
HAS COME TO A  
COMPLETE STOP.


IS SHE FOR REAL?

A-A-A-AH  
CHOO!

GESUNDHEIT!







WE'RE BACK!

We were going so fast,  
we couldn't see anything,  
but we could tell we were getting bigger.  
Then—thud!—we landed.  
There we were, back at school.  
And there was Arnold,  
in the school parking lot,  
blowing his nose.

LOOK! THERE'S  
ARNOLD!

THUD



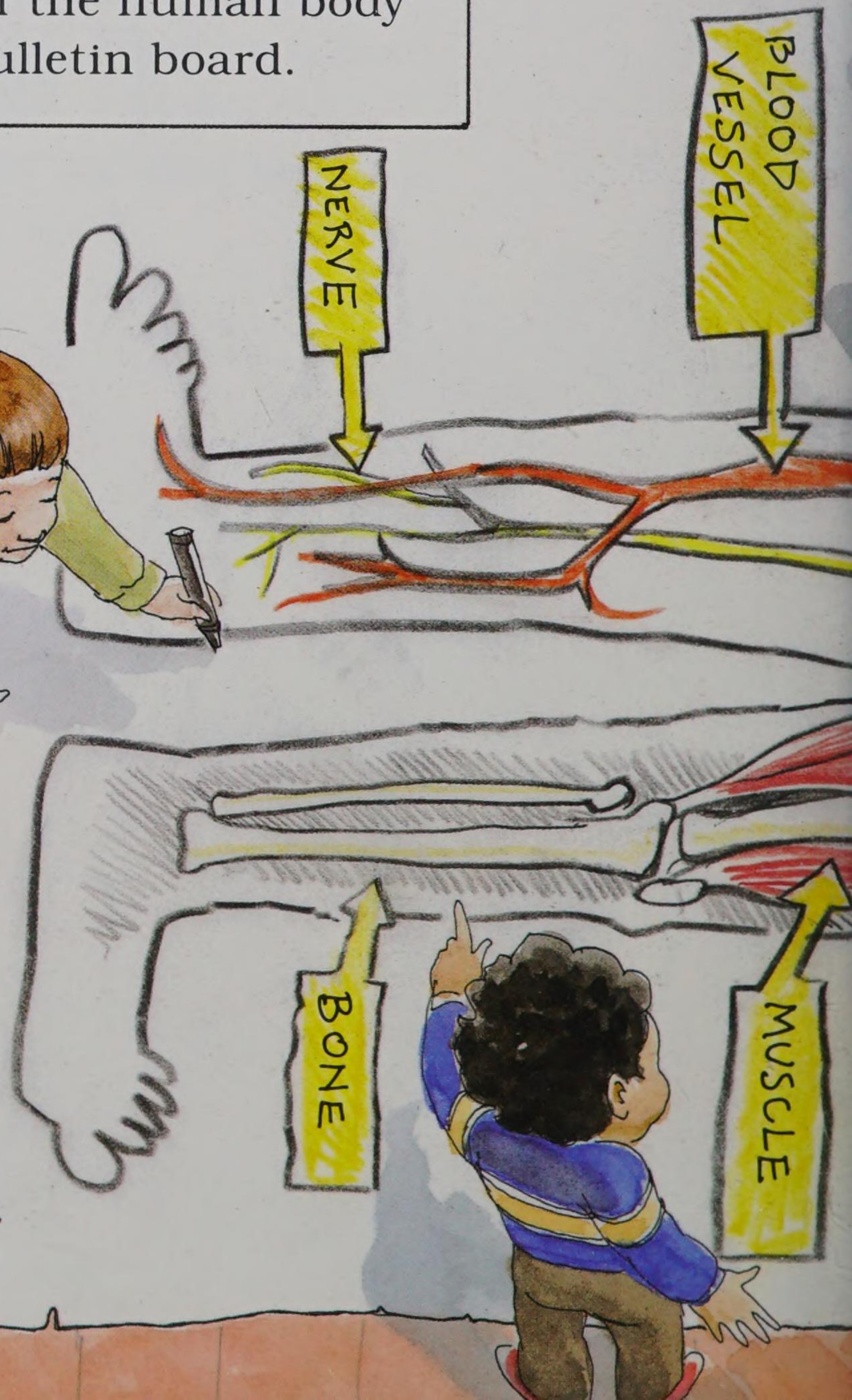
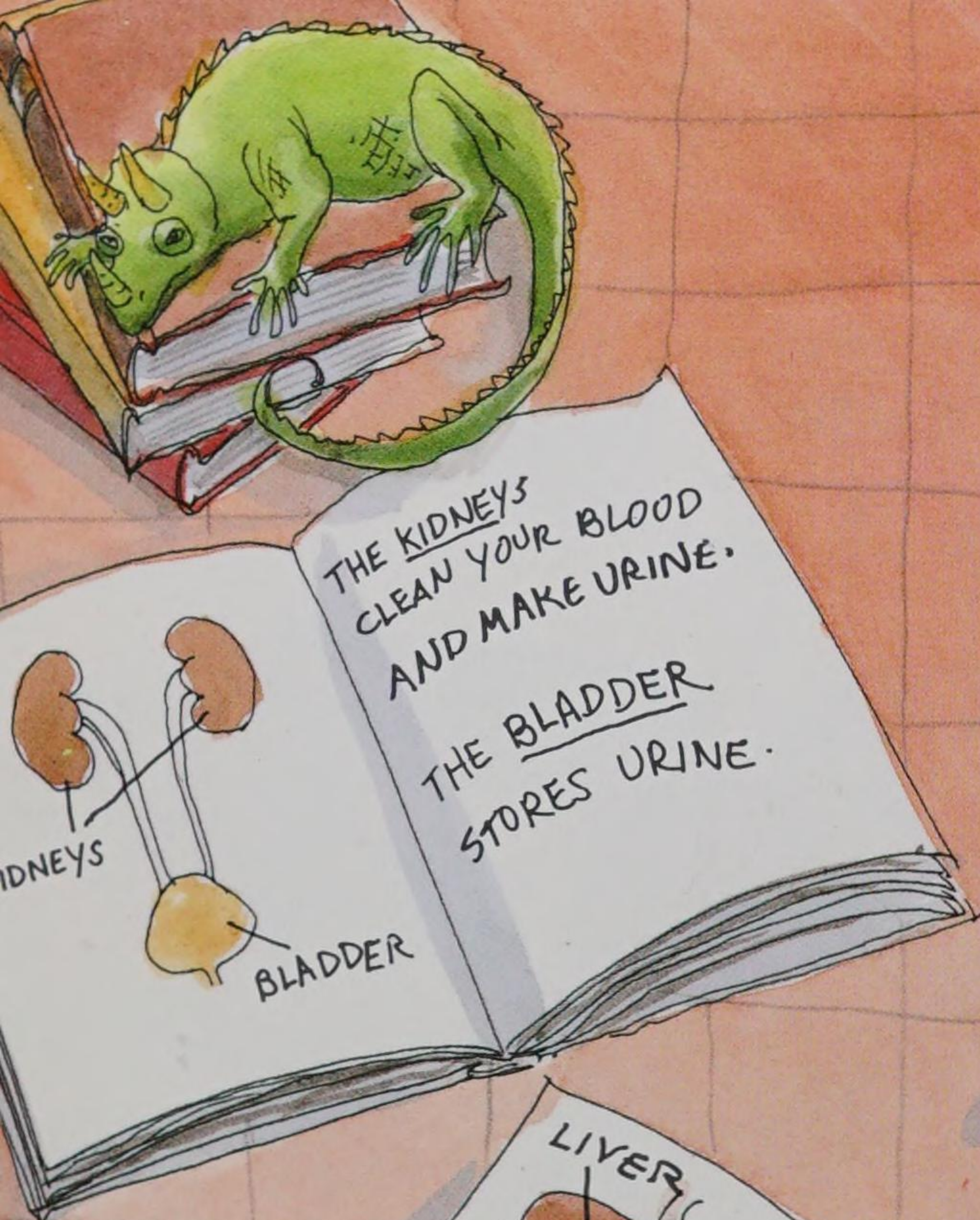
“Arnold!” we said, “the trip was *amazing*!  
You should have been there!”

WHERE WERE YOU?





Back in the classroom,  
it was business as usual.  
Ms. Frizzle made us draw  
a chart of the human body  
for the bulletin board.

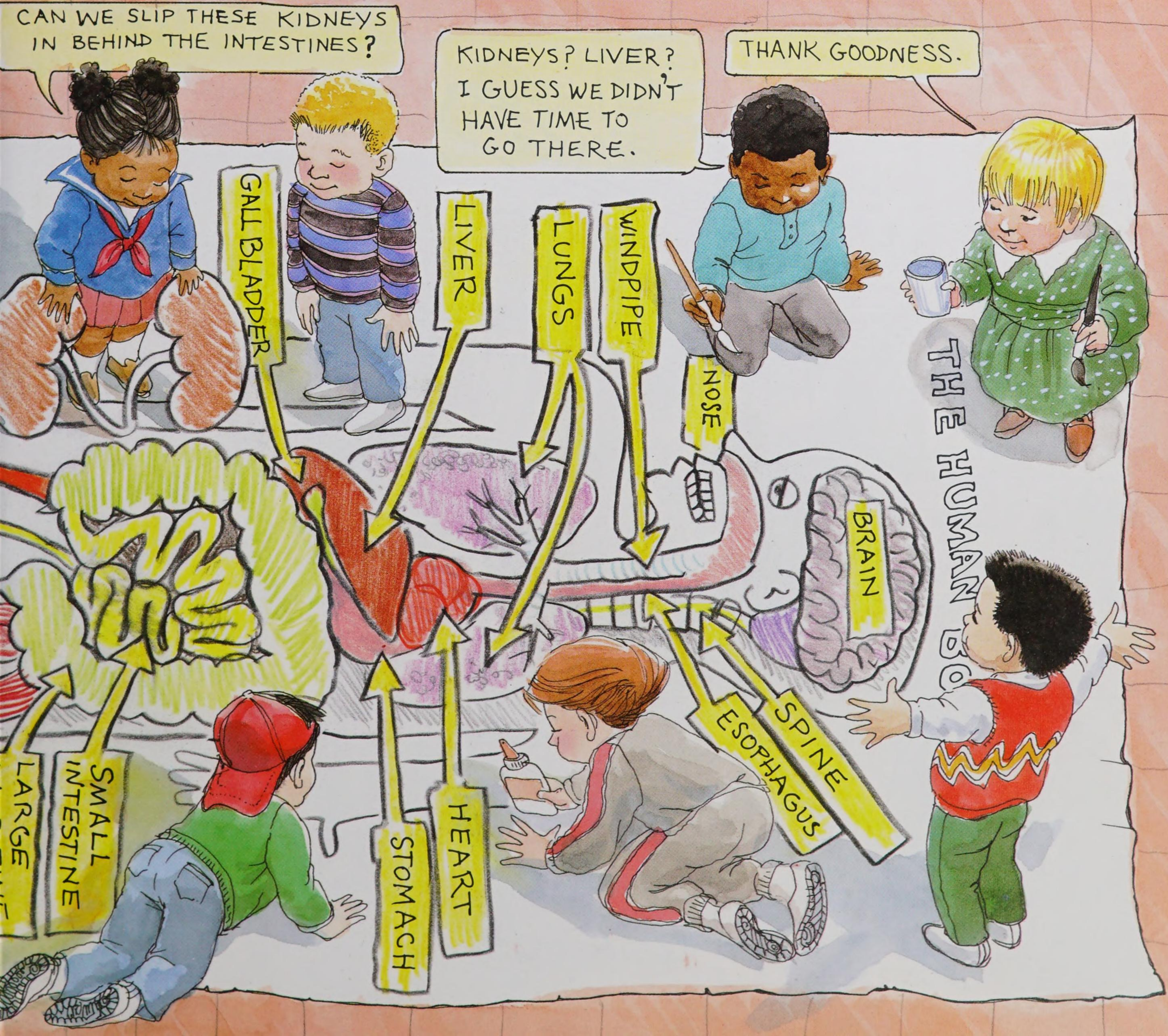




CAN WE SLIP THESE KIDNEYS  
IN BEHIND THE INTESTINES?

KIDNEYS? LIVER?  
I GUESS WE DIDN'T  
HAVE TIME TO  
GO THERE.

THANK GOODNESS.



THE HUMAN BODY

GALL BLADDER

LIVER

LUNGS

WINDPIPE

NOSE

BRAIN

SPINE

ESOPHAGUS

HEART

STOMACH

SMALL  
INTESTINE

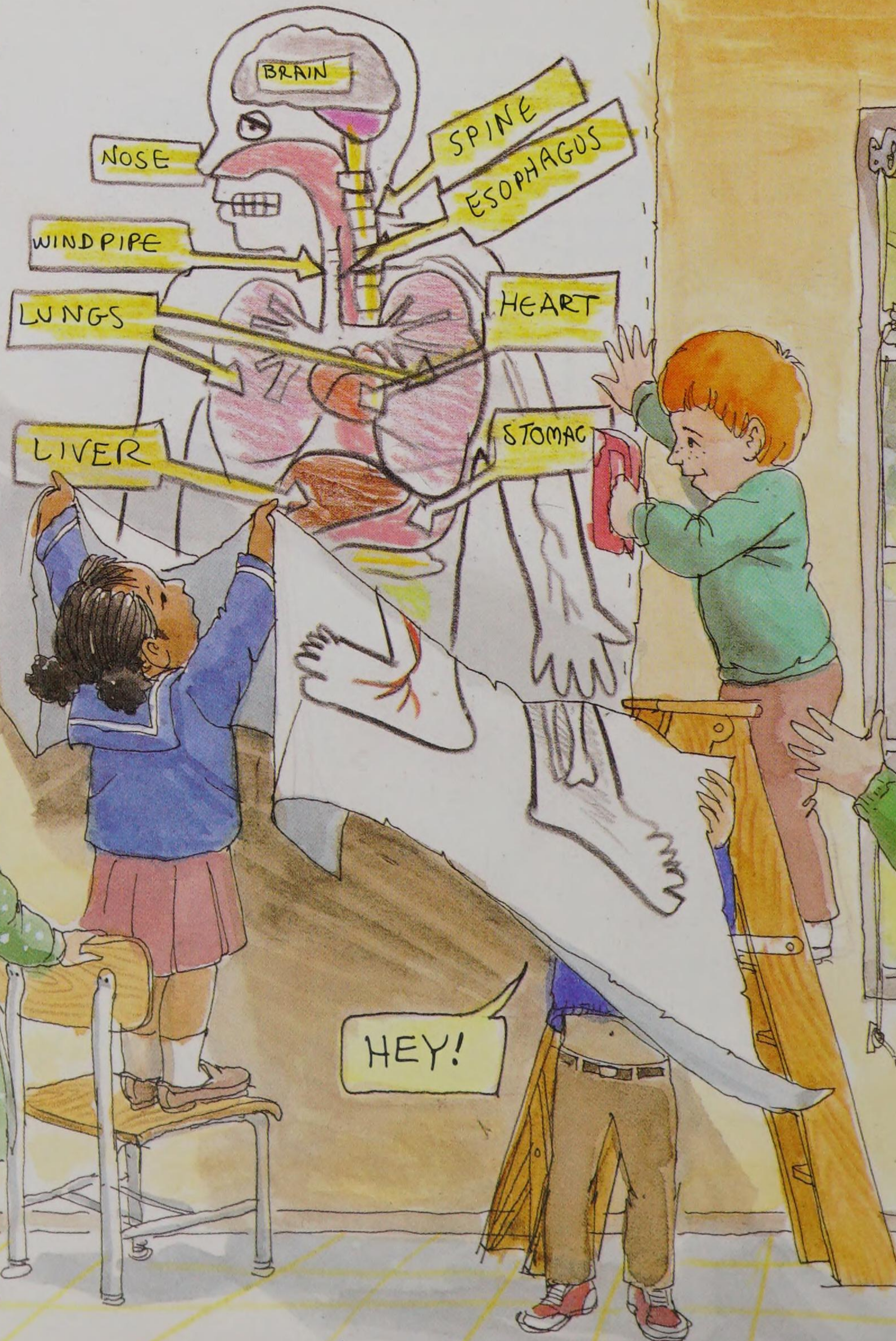
LARGE  
INTESTINE



WHAT A TRIP!

I'D LIKE TO  
GO TO THE  
LUNGS AGAIN.

I'D RATHER  
GO TO  
HAWAII.



HEY!

THE HEART



At last, everything was quiet in Ms. Frizzle's class—everything, of course, except her dress!

SHE MUST BUY HER CLOTHES IN OUTER SPACE.

DON'T GIVE HER ANY IDEAS!

RED BLOOD CELLS ARE CUTE!



by Molly

My Favorite Organ  
by Carmen



THE NOSE  
It's a Front-runner

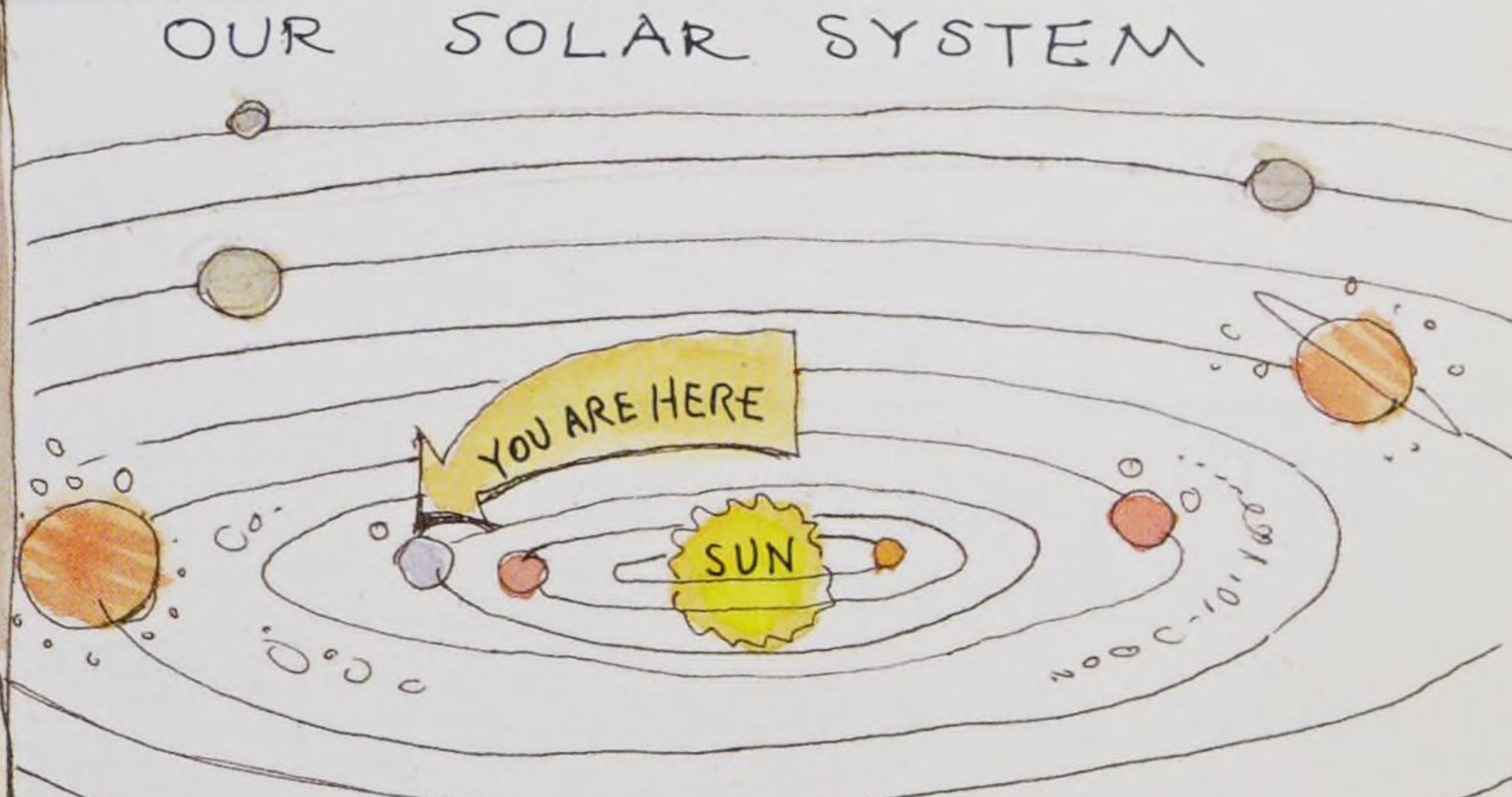
My favorite Organ  
by Arnold  
A FULL STOMACH.



MY LUNGS

KEEP THEM CLEAN  
by Tim

I ♥ MY EARS  
by WANDA





## TRUE-OR-FALSE TEST

### HOW TO:

Read the sentences below. Decide if each one is true or false. To see if you are correct, check the answers on the opposite page.

### QUESTIONS:

1. A school bus can enter someone's body and kids can go on a tour. True or false?
2. Museums are boring. True or false?
3. Arnold should not have tried to get back to school by himself. True or false?
4. Children cannot breathe or talk when they are surrounded by a liquid. True or false?
5. If the children really were as small as cells, we couldn't see them without a microscope. True or false?
6. White blood cells actually chase and destroy disease germs. True or false?
7. Ms. Frizzle really knew where Arnold was the whole time. True or false?

STOP! TAKE THIS TEST!  
DO NOT WATCH T.V....YET.  
DO NOT GET A SNACK...YET.  
DO NOT PLAY A VIDEO  
GAME...YET.  
FIRST TAKE THIS TEST.





## ANSWERS:

1. False! That could not happen in real life. (Not even to Arnold.)

But in this story the author had to make it happen. Otherwise, the book would have been about a trip to a museum, instead of a trip through the body.

2. False! Museums are interesting and fun. But they are not as weird and gross as actually going inside a human body.

3. True! In real life, it would have been safer if Arnold had found a police officer to help.

4. True. If children were *really* inside a blood vessel, they would drown. It must have been magic.

5. True! The pictures in this book show the cells and the children greatly enlarged.

6. True! As unbelievable as it seems, real white blood cells actually behave just like the ones in this book. They even squeeze through the cells of blood vessel walls to capture germs in your organs and tissues.

7. Probably true. No one is absolutely sure, but most people think Ms. Frizzle knows *everything*.



















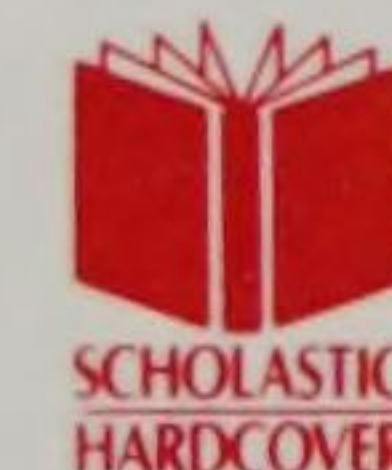
Both **Joanna Cole** and **Bruce Degen** loved science when they were in elementary school. So it's no wonder this talented pair enjoys collaborating on the Magic School Bus science series. What is surprising is that neither of them ever rode a school bus. They both walked to school, Joanna to Columbia Grammar School in East Orange, New Jersey, and Bruce to P.S. 156 in Brooklyn, New York.

Then again, maybe it was all that walking that made school buses seem magic to Bruce and Joanna.

Don't miss these other exciting Magic School Bus adventures by Joanna Cole and Bruce Degen:

**THE MAGIC SCHOOL BUS AT THE WATERWORKS**  
**THE MAGIC SCHOOL BUS INSIDE THE EARTH**

*Jacket art © 1989 by Bruce Degen*



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